ENGINEERING NEWS-RECORD

JANUARY 24, 1946

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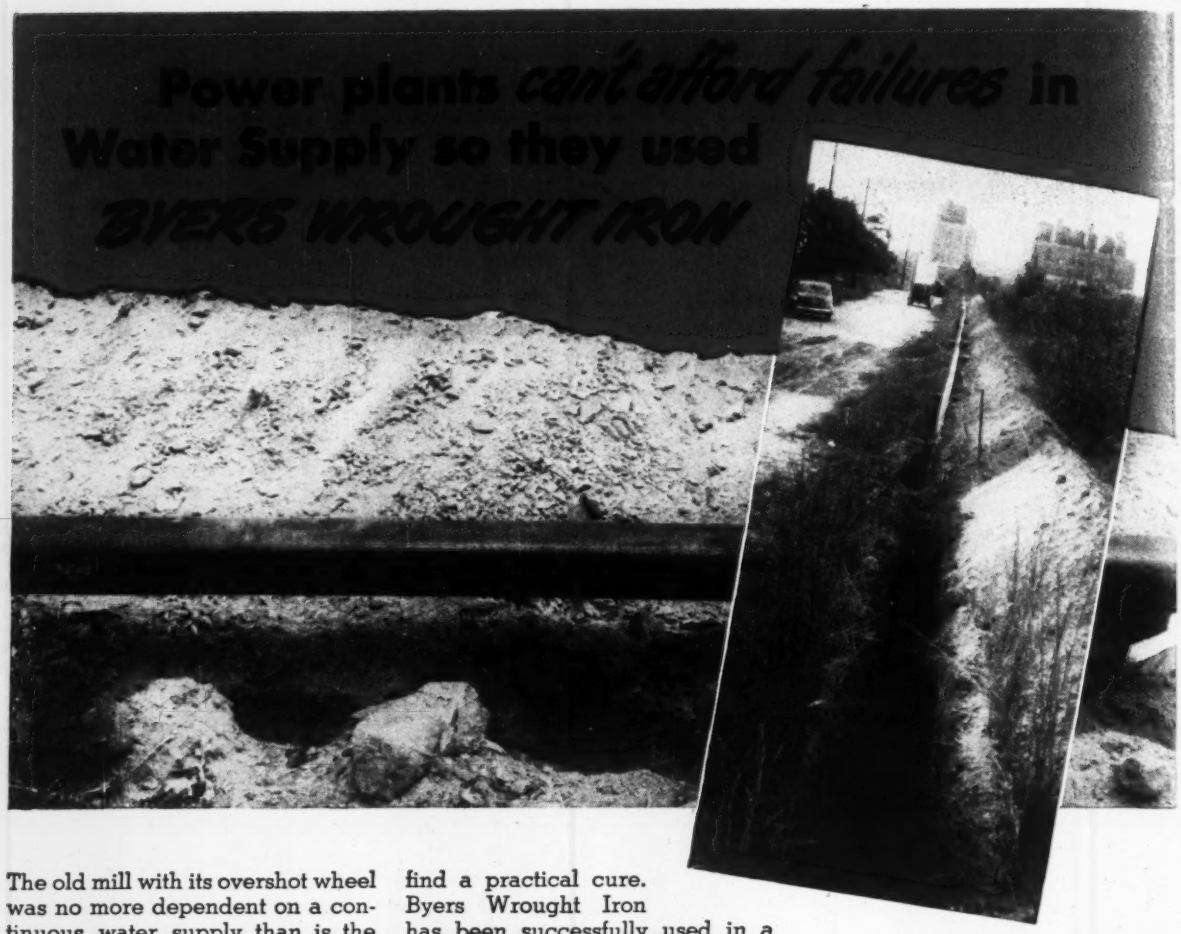
NEW YORK'S BIG AIRPORT FOR WORLD COMMERCE

DESIGN OF A 152-FT. RIBLESS CONCRETE DOME

WHY WE NEED BETTER CONSTRUCTION INSPECTION

Power plants *can't afford failures* in Water Supply so they used *BYERS WROUGHT IRON*



The old mill with its overshot wheel was no more dependent on a continuous water supply than is the modern power plant. The factor of dependability was given proper weight when the Georgia Power Company recently installed an underground line from its Atkinson Steam Plant near Atlanta, to the city mains 4000 feet away. The 6, 8 and 10-inch pipe used was Byers Wrought Iron. Williams Bros. Corporation of Chamblee, Ga., were the contractors on the job.

Every underground pipe installation should be planned with particular care, for in addition to the corrosion that may come from the fluid within, severe attack should be anticipated from the soil without. Soil types, electrolytic and galvanic action, and bacterial action all play a part in determining the type and severity of attack, and help to make the subject of soil corrosion one of the most complex that the student of this subject encounters.

Fortunately, it isn't necessary to have a complete theoretical knowledge of soil corrosion in order to find a practical cure. Byers Wrought Iron has been successfully used in a wide variety of locations, representing most of the conditions that will be encountered, and its record provides an excellent guide in specifying. For instance, a 50-inch underground water line is still serving in a Pennsylvania community after 60 years of use . . . and only one leak has ever been reported. An engineer reported a 21-year-old wrought iron line still in service in southern marshland, where ordinary materials failed in as little as four years. These are but two examples from many.

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Proposed Engineering Construction Backlog and Advance to Active Status

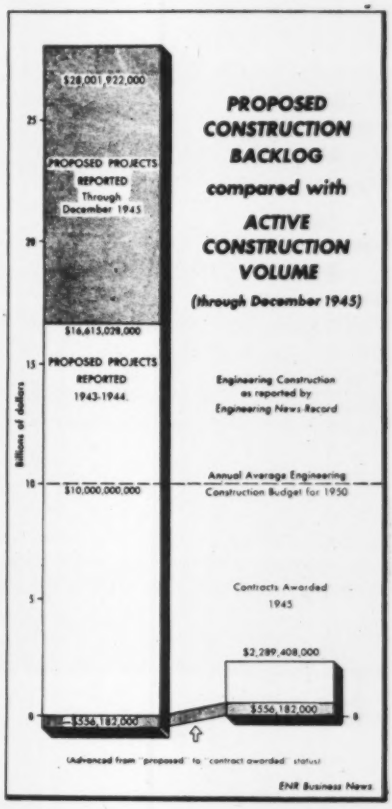
Year end construction backlog at $28,001,922,000, after $556,182,000 had advanced to active status. The $11,386,894,000 added to the backlog in 1945 is 1 percent below total added in 1944.

The cumulative proposed construction backlog measured from January 1943 through December 1945 is $28,001,922,000. This total remains after $556,182,000 worth of projects that have already advanced to active status of contract awarded has been subtracted from the proposed construction backlog. During the year 1945 $11,386,894,000 in proposed construction projects were added to the measured backlog over and above the $556,182,000 that moved out of proposed and into contract awarded status. This $11,386,894,000 can be compared with the amount added during 1943, $5,101,089,000, and in 1944, $11,513,939,000.

Breaking down the $28,001,922,000 backlog geographically, the Middle Atlantic states lead with their $7,036,974,000 forming 25 percent of the country's total. The other sections follow: West of the Mississippi, 22 percent; Far Western, 21 percent; Middle West, 18 percent; Southern, 9 percent; New England, 5 percent.

The proposed backlog for public construction, $23,956,942,000, is 86 percent of the total for the U. S. with the $4,044,980,000 private construction backlog making up the remaining 14 percent. The gradation of the nine classifications of construction with respect to their backlog shows that earthwork and drainage with its $6,892,444,000 backlog the leader forming 25 percent of the total. The other classes are as follows; public buildings, 21 percent; unclassified, 17 percent; highways, 13 percent; commercial buildings, 7 percent; industrial buildings 5 percent; sewerage, 5 percent; bridges, 4 percent and waterworks, 3 percent.

Of the $556,182,000 that has been advanced to active status during 1945, $279,519,000 has been in private construction and $276,663,000 in public construction. Geographically, states West of the Mississippi lead the advance to active status with their $189,440,000 forming 34 percent of the nation's total. Middle Western states follow with 20 percent of the total while Middle Atlantic states are next with 19 percent. The other sections are as follows: Far West, 16 percent; Southern, 7 percent; New England, 4 percent. Leading the advance to active status by class of work is industrial buildings with its $162,549,000 making up 29 percent of the total. Percentages of the total advanced in the other classes are: public buildings, 27 percent; unclassified, 20 percent; commercial buildings, 12 percent; waterworks and earthworks and drainage, 6 percent.



CONSTRUCTION ADVANCE TO ACTIVE STATUS—BY CLASS OF WORK—BY SECTIONAL DISTRIBUTION

(Thousands of Dollars)

Class of Work	ENR Measured Backlog of Proposed Construction	% of total	Advanced to Active status during 1945	% of total	% of Proposed advanced to contract awarded
Waterworks	$873,721	3	$24,736	4	2.8
Sewerage	1,549,055	5	11,487	2	.7
Bridges	1,144,178	4	4,295	1	.4
Earthwork—Drainage	6,892,444	25	23,048	4	.3
Streets—Roads	3,727,677	13	7,565	1	.2
Public Buildings	5,084,802	21	148,783	27	2.9
Industrial Buildings	1,331,278	5	162,549	29	12.2
Commercial Buildings	1,901,289	7	68,052	12	3.6
Unclassified	4,777,478	17	105,665	20	2.2
TOTAL DEC. 31, 1945	**$28,001,922**	**100**	**$556,182**	**100**	**2.0**
Total Dec. 31, 1944	**16,615,028**				
Total Dec. 31, 1943	**5,101,089**				

Sections	ENR Measured Backlog of Proposed Construction	% of total	Advanced to Active Status during 1945	% of total
New England	$1,337,574	5	$21,593	4
Middle Atlantic	7,036,974	25	108,665	19
Southern	2,472,392	9	39,242	7
Middle West	5,050,869	18	108,846	20
West of Mississippi	6,303,078	22	189,440	34
Far West	5,801,035	21	88,396	16
	$28,001,922	100	$556,182	100

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ENR-H-76

News of the Week

ENGINEERING NEWS-RECORD • JANUARY 24, 1946 • VOLUME 136 • NUMBER 4

Push road building to the limit, ARBA told

Adverse Congressional action possible if program is not expedited to meet urgent users' demands

Despite several threatening bottlenecks, our national highway construction program must be pushed to the limit in the next few years to meet demands of the highway user and possible adverse Congressional reaction. This statement by an outstanding highway authority, together with an urgent need for reduction of traffic fatalities through improved highway design and construction were two of the chief matters discussed at the 43rd annual convention of the American Road Builders Association held in Chicago Jan. 14-17.

With ample funds having been authorized under the Postwar Federal-Aid Highway Act of 1944, and with sufficient plans completed for more work than can be executed this year, it now becomes a problem of getting the program under way and at as rapid a pace as possible. Congressmen J. W. Robinson, chairman of the House Roads Committee, and Jennings Randolph, member of the same committee, both warned that unless the 3-year, $3 billion roadbuilding program is accelerated at once it may have an adverse effect on future Congressional roadbuilding authorizations, upon which hearings are expected to begin probably in 1947.

Two threats to program

At the opening session of the 4-day meeting, which had a registration of more than 1,300 and a total attendance exceeding 2,000 persons, Charles M. Upham, engineer-director of the association, discussed briefly two serious threats to the speedy inauguration of the national highway construction program. They are the shortage of experienced men in the state highway departments, and the lack of agreement between the engineer's estimates and contractors' bid prices, which has resulted in the bids being rejected (*ENR* Jan. 10, vol. p. 40).

Chief reason for the shortages of engineers is the alarmingly low salary rates paid by many highway departments. These rates must be raised, said Mr. Upham, not only to keep those engineers now in the highway departments, but to attract new engineers to this field. Even after the return of all service men now overseas, there will be 10,000 fewer engineers in highway construction than there were before the war, he said.

As one solution to the shortage of en-

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ASCE plans expansion of research programs

Committee set up to coordinate expanding research operations that are anticipated under pending legislation

Planning for more research and for better coordination of that research in the many fields of the society's activities stands out as the high spot of the 93rd annual meeting of the American Society of Civil Engineers held in New York January 16-19.

To head this work, the new president, W. W. Horner, named a research committee to keep in close touch with national developments and to insure that full advantage be taken of opportunities to advance research in which the society is interested. Boris A. Bakhmeteff, professor of civil engineering at Columbia University, newly elected to honorary membership in the society, was named chairman. Other members of the committee are: Thorndike Saville, Wilbur M. Wilson, George R. Rich, A. E. Cummings, Frank A. Marston and Roy W. Crum.

Appointment of a permanent research committee was recommended to the Board of Direction of the society by an interim research committee set up at the time of the October board meeting, but as the activities of such a committee would overlap those of the society's Committee of Division Activities, decision as to a permanent committee was put off until the two committees can study the subject further.

Federal aid for research

The growing need for more basic research in engineering was stressed by Dr. Bakhmeteff in a stimulating talk at the luncheon meeting on Wednesday during which he reviewed the progress made with bills now before Congress calling for large federal grants to stimulate research. Dr. Bakhmeteff said that the original bills contain no reference to the engineering sciences, but that as a result of the activities of the Engineers Joint Council and the Engineering College Re-

(*Continued on p. 54*)

La Due nominated for presidency of AWWA

Wendell R. La Due, chief engineer of the Akron, Ohio, Water and Sewage Bureau, was nominated for the presidency of the American Water Works Association at a meeting of the directors held in New York Jan. 15. At the same time, N. T. Veatch, Jr., consulting engineer of Kansas City, Mo., was nominated for vice president, and William Brush, editor of *Water Works Engineering*, for reelection as treasurer. Balloting for these officers will be conducted by mail.

Elected to honorary membership were John R. Baylis, physical chemist of the Department of Public Works, Chicago, and E. G. Ritchie, formerly chief engineer of the Metropolitan Water District of Melbourne, Australia.

W. R. La Due

Harry E. Jordan, secretary of the association, said that the only other action of public interest taken by the Board of Directors was award of the John Goodell Prize, established by *Engineering News-Record*, to C. M. Riedel, design engineer of the Chicago Bureau of Engineering, for his paper on chemical soil solidification and chemical sealing of leaking concrete; and the award of the John M. Diven Medal to J. C. Harding, commissioner of public works for Westchester (N. Y.) County, for his leadership of the association's committee that developed specifications for deep wells.

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search Association, engineering is now included in the bills under study in Congress.

In laying special emphasis on the need for basic research in engineering sciences in this country, Dr. Bakhmeteff said that while we had been leaders in technological developments in the past, we had lagged behind Europe in making the basic studies on which such development must be based, and that we now must take the lead in such research. Doing that will not be easy, he said, and he urged that engineers make their opinions heard on such national matters through the Engineers Joint Council. As an example of what the EJC can do he cited the recent statement by the council with respect to German industry, an action in which Malcolm Pirnie, past president of the ASCE, took such an active part.

Regional meetings authorized

All wartime restrictions on society activities were ended by the Board of Direction at its meeting held in advance of the general meeting. A regional spring meeting of the society is to be held at Philadelphia, the annual summer convention will be at Spokane, and the fall meeting will be in Kansas City.

As the outcome of recommendations made to it by an exploratory conference on means for expanding the society's membership and improving its service to the public, held January 10-11, the board instructed its policy forming committees to study the conference committee recommendations and to be ready with recommendations at the April board meeting.

At the annual business meeting, the new secretary and executive officer, William N. Carey, reported that the membership had now passed the 21,000 mark, a gain of nearly 700 over last year.

Sea-level canal favored

Strong arguments in favor of an early start on conversion of the Panama Canal to a sea-level channel were made at a joint meeting of the Construction and Waterways divisions by John G. Claybourn, superintendent of the dredging division, at the Panama Canal. When work is resumed on the third-locks project, which was stopped because of the war, Mr. Claybourn recommends that the new locks be designed to facilitate the progressive widening and deepening of the canal so that it ultimately can be cut down to sea level.

Cutting the canal down to sea level and providing a 500-ft. wide channel with a depth of 55 ft. would cost $1,310,400,000,

(*Continued on p. 55*)

More research on earth dams urged

Much more research is needed in the field of earth dam design before such designs can be placed on a more rational basis, members of the ASCE Soil Mechanics and Foundations Division said in discussing aspects of the problem in their section of the society's annual meeting.

Ralph B. Peck, research assistant professor of the University of Illinois, outlined the work planned by the recently organized subcommittee on measurement of pore pressures, describing the principal devices now used to measure such pressures.

No one of these devices satisfies all requirements, he said, and most of them have given unsatisfactory or inconclusive results. One reason for this, Prof. Peck said, is failure to continue to take observations on devices that have been installed in dams and then seemingly forgotten.

He observed further that most of the devices so far built have failed to function a short time after installation.

Much the same experience was reported by J. O. Osterberg, assistant professor at Northwestern University, who described in detail the pressure cell developed at the Waterway Experiment Station at Vicksburg. Some of these cells, which are expensive to build and to install, were put in Don Martin Dam and others were installed under Mississippi River levees. All of the latter are out of service, and about half of the ones at the dam are also out.

Another pressure cell, the Carlson-Terzaghi cell, was described by John Lowe III of Massachusetts Institute of Technology. Its advantages over the experiment station cell is that deflection of the diaphragm is measured perpendicular to the diaphragm, hence it does not need to be so sensitive as the other cell, which has a strain gage cemented to the diaphragm. A modified design of the Carlson cell is now being tested.

Stability of dams

A comparison of various methods for determining the stability of earth dams was reported in considerable detail by T. A. Middlebrook, chief of the soil mechanics division, geology and geophysical section, in the Office of the Chief of Engineers. Three embankment sections with quite narrow margins of safety were submitted to a large number of authorities on earth dam design with a request that they determine their stability by using one or more of the common methods of determination. The results showed a wide variety of factors of safety depending on the individual who made the determination and the method used.

In discussion, Theodore T. Knappen, New York consulting engineer, said that at best, solutions of this kind were only as good as the information as to materials in the dam and in foundations, consolidation of materials and pore pressure. Sampling and testing must be very thorough, and if the stability is at all in question, due to the lack of suitable materials, construction of test sections of the dam would be highly desirable.

Consolidation of embankments

Methods for field and office control of materials going into earth dams were reviewed in a subcommittee report prepared by Robert R. Philippe, principal engineer, Ohio River Laboratories, and presented by William P. Creager, consulting engineer of Buffalo. Mr. Philippe said that we now have reasonably complete knowledge of methods for selecting and consolidating soils in dams, but that there is not proper integration of this knowledge with design theories and actual designs. As a result, some structures are unnecessarily stable, others lack adequate stability, and still others may be too rigid for the foundations on which they are built.

Failure to base designs on knowledge of the available materials was criticized in two written discussions of the report.

Studies of seepage and drainage in earth dams and levees were outlined in a subcommittee report presented by Prof. Phillip C. Rutledge of Northwestern University. Detrimental effects of seepage in sufficient quantities to produce erosion also were covered in the report.

Slope protection

The symposium on earth dam design concluded with a report of the subcommittee on slope protection, summarized by Robert A. Sutherland, in the absence of the chairman. Included in the report were the principal formulas used to determine the force of wave attacks and for establishing the size of stones to be used for rip-rap. Brief descriptions of various types of slope protection, such as grouted rip-rap and concrete slabs also were included. As to the latter, the report emphasized the need for joints and for vents through the slab to drain out water that might get back of the slab.

The Corps of Engineers, according to the committee, is soon to make large-scale tests of slope protection in a wave tank.

Sharp criticism of the committee for proposing to republish old wave-action formulas just as the Army Engineers are beginning their studies was voiced by L. F. Harza, of Chicago. Mr. Harza also criticized the committee's statement about the need for joints and vents in concrete slabs, and for filter blankets under slab.

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and would require 12 years of work, according to Mr. Claybourn. A width of 1,000 ft. could be attained by an added expenditure of $600,000,000.

Cutting the present canal down to sea level would cost just about as much as building a second canal across Nicaragua, and would be a much more satisfactory proposition both from a military viewpoint and from the viewpoint of traffic capacity.

Mr. Claybourn stated that construction of the third set of locks would not increase the capacity of the canal sufficiently to make it adequate for all time, and that ultimately, traffic needs would make a sea level canal of still greater capacity necessary. From a military viewpoint, a lock canal is much more vulnerable to attack. He holds that there would be little risk of a sea level canal being closed by slides caused by heavy bombing, and that even though the canal might be closed temporarily, it could be put back into service much more quickly than could a badly damaged lock canal.

Experience gained in removing the slides in the present canal, and the new knowledge of soil mechanics that has been developed since the Panama Canal was built, gives assurance, according to Mr. Claybourn, that the much greater cuts required for the sea-level canal can be made without serious trouble. The major problem involved in converting the present canal to a sea-level canal is the matter of handling floods. However, the canal staff has worked out plans for doing that through the construction of additional storage reservoirs and diversion channels.

Rhine River forecast studies

A narrative account of U. S. Army Engineer forecasting work that preceded the bridging of the Rhine River was presented at the symposium on hydrology by Franklin R. Snyder, hydraulic engineer in the office of the Chief of Engineers. Mr. Snyder described detailed research and studies carried out to assure that the crossings, as originally planned, would be made during favorable river stages.

Walter B. Langbein, associate engineer with the U. S. Geological Survey, described advanced methods of extending stream flow records. Although major progress is being made in this type of work, Mr. Langbein said, much remains to be done and great care must be exercised to avoid making assumptions that will lead to misleading results.

A discussion by Adolph F. Meyer, Minneapolis consultant, of methods of

(*Continued on p. 56*)

Score use of prepared sanitary plans

Use by sanitary engineers as their own of any plans prepared by promoters or manufacturers of patented articles and processes is not only unethical but also unwise, members of the Sanitary Engineering Division were told at their section of the ASCE's annual meeting.

This admonition was included in a report of the Committee on the Evaluation of Professional Objectives in the Design of Sanitary Engineering Works, submitted by Thomas R. Camp, Boston consulting engineer. One of the highlights of the division's meetings, the report should dispel any confusion that exists in the minds of sanitary engineers concerning the use of plans and specifications prepared by manufacturers of patented processes.

The committee decried the customary practice of some designing engineers specifying that the contractor shall assume liability for the payment of royalties or for patent infringement. While the procedure is intended as a protection for the client, it is, in fact, an avoidance of the question of patents by the engineer. It was also pointed out that some of the process patents obtained in recent years appear to be restrictions on established practice in that they purport to cover combinations of processes that have been used previously, or establish limits on certain design factors or rates that may be used without infringement.

Promotion of patented articles and processes in the field of water and sewage treatment is not new, said the committee, but the practice has grown to such an extent recently that it threatens to interfere with conventional practice in the design of sanitary engineering work.

The responsibility for successful and economical performance of the plant rests squarely with the engineer, and, among other things, he should be familiar with patents and patent protection.

The complete report of the committee is scheduled for publication in the January, 1946, Proceedings of the ASCE.

Rising construction costs will reach 50 percent above 1940 levels by 1950, and in certain types of work, such as pipe lines and sewer installations, which involve a large amount of common labor, the increase may be even greater, said Louis R. Howson, Chicago consultant.

Mr. Howson made the gloomy prediction that rising costs "will materially retard construction and much public works will be deferred or abandoned."

Stream pollution aid

Attention of the division was directed by Seth G. Hess, chief engineer of the Interstate Sanitation Commission, New York, to a new process for descaling metals, whose wide application may have a profound effect on the elimination of pickling wastes pollution of streams. Mr. Hess called on Manley L. Ross, manager of the sodium and cyanide products development of the E. I. Du Pont de Nemours Co., Niagara Falls, to tell of the sodium hydride process whose application has been deferred because of war restrictions.

In brief the process provides for an alkaline treatment, the wastes from which are relatively small in volume and which can be easily neutralized. This small volume and relatively easy neutrali-

(*Continued on p. 56*)

Seek strong Army sanitary organization

Dissatisfaction among sanitary engineers who feel that their services were not given most effective use by the Army, was expressed in a resolution offered by the Committee on Advancement of Sanitary Engineering, the chairman of which is Gordon M. Fair, Harvard Graduate School of Engineering.

The resolution approved by the Board of Direction of the ASCE asks "strong representations" to the Army and the Congress that there be maintained within the Army an effective sanitary engineering organization, and that if such an organization is established within the Medical Department it should be based, among other things, on the establishment of a separate engineering organization and equality with all other corps of the Medical Department in regard to rank, promotion and opportunity.

The resolution further requested that if a study indicates the advisability of grouping all sanitary engineering in a special division in the Corps of Engineers rather than the Medical Department of the Army, education and experience requirements should not be less than seven, and preferably eight, years of technical education and experience, including a degree from a recognized engineering college.

Another resolution placed the society's support on the side of the Spence bill, (HR 4070) for stream pollution control, which would exercise national control through the police power of existing state health agencies. The resolution further disapproved the concept of federal control and jurisdictional authority contained in the provisions of HR 519 and 587.

ASCE Plans Expansion

(*Continued from p. 55*)

presenting testimony before juries received favorable comment. Mr. Meyer described the extensive studies and great care that were used in presenting engineering data before two Minnesota juries.

Hydraulics Division

How civilian geologists and engineers improved drinking water for military use was described by A. M. Sayre, geologist, U. S. Geological Survey, in a talk before the Hydraulics Division meeting, based on the premise that unsanitary conditions, particularly as to water, are more dangerous than all other enemies in war.

Discussion brought out the fact that the Japanese did not deliberately destroy, either by filling in or by poisoning, any of the water supplies on the islands from which they were driven.

Stifel W. Jens, an associate of Horner and Shifrin, St. Louis consultants, presented a plan for partial ponding of surface waters by use of restrictive outlets to reduce the cost of airport drainage.

Papers presented on surface runoff under the auspices of the Hydraulic Division, were largely graphs and technical data that are beyond the scope of this report.

A dimensionless hydrograph for overland flow was explained by Carl F. Izzard, senior highway engineer of the Public Works Administration.

Groundwater studies

The program of the Engineering Economics Division inaugurated the plan of the new committee, appointed last year, on the economic importance of groundwater, to study and promote the efficient use of this major natural resource. A total of 13 papers are in process of preparation, and three of these, relating to water wells, were presented at this meeting. James C. Harding, Commissioner of Public Works, Westchester County, N. Y., Carl Rowher, U. S. Soil Conservation Service, Fort Collins, Colo., and Robert S. Charles, president, Layne-New York Co., were the authors. Ernest W. Bennison, of Edward E. Johnson, Inc., St. Paul, Minn., and chairman of the committee, pointed out that emphasis in all of the papers will be on development and use of groundwater rather than on its hydraulics. The other papers will be presented at future meetings of the Society.

Radar for surveying work

Two methods of measuring distances by radar that appear to hold considerable value for surveyors were described at an informal symposium of the map-

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Propose urban traffic problem solution

Improved mass transportation, coupled with enforcement of on-street parking bans, were suggested by a symposium on traffic at a joint session of the highway and city planning divisions of the ASCE as the best means of eliminating street congestion. Discussion was limited almost wholly to traffic troubles of the largest metropolitan areas.

The general subject was introduced by Leslie Williams, city planning engineer, American Transit Association, who said that losses due to traffic congestion in 1941 were estimated at $2,000,000. Communities in general have a "feeling of helplessness" about the situation which, Mr. Williams pointed out, tends to be self-limiting to the extent that traffic naturally reduces itself as business goes away from the inaccessible areas.

A solution for this problem was put forward by Walter J. McCarter, general manager of Cleveland's publicly-owned transit system. Based on some very comprehensive surveys, Cleveland has instituted four separated zones with a higher fare for greater distance and better service. It has been the experience there that people are much more interested in a good ride than in a cheap one and that people particularly dislike spending more than 30 minutes in transit.

Recent surveys in Philadelphia, described in a paper by Robert A. Mitchell, chief, Bureau of Traffic Engineering, of that city, indicated that only 3 percent of the persons entering Philadelphia's business district during shopping hours came in cars parked at the curb.

F. W. Lovejoy of the Public Roads Administration told the group that 15 states already have laws authorizing condemnation to obtain space for off-street parking, and that authorization for it exists in many other cities. Private and public parking facilities are far behind actual needs in very nearly all large cities but experience has not yet proved that parking facilities are a sound investment unless parking bans are strictly enforced.

Commenting on the part played by parkways and freeways, William S. Chapin, of the Triborough Authority and the New York City Tunnel Authority, said that average city streets have 20 to 30 percent capacity compared to nearly 100 percent for expressways where there are no crossings at grades. The major traffic load in all cases is in or near large cities or important industrial plants. Federal allotments are being revised somewhat to meet city area needs. Mr. Chapin said that expressways are needed virtually to bridge every community and that New York City has at least some plans for about $285,000,000 worth of such traffic arteries.

H. Everett Kincaid, executive director of the Chicago Plan Commission, told the symposium about Chicago's plan for decentralization of that city into integrated communities seperated by expressways and thoroughfares that would make rapid-transit possible without traversing community streets. Under this plan residential districts would average about 65,000 people. Each of these districts would have from 4 to 12 neighborhoods so situated that it would not be necessary for pedestrians to cross the major streets frequently to reach schools, playgrounds or local shopping centers.

Sanitary Division

(*Continued from p. 55*)

zation apparently are in striking contrast to the end products from the common use of acid neutralization.

Mr. Ross told *Engineering News-Record* that the potentialities of the process as an aid in stream pollution abatement had not been considered by his company until Mr. Hess brought the matter to his attention a few days before the meeting.

Wide variety of subjects covered

Other papers, some abstracts of which will be published in forthcoming issues, included plans for water system improvements at Philadelphia, by Eugene A. Hardin, project engineer of the Philadelphia Bureau of Water; operating experiences at Chicago's South District water filtration plant, by W. W. DeBerard, city engineer, and John R. Baylis, physical chemist, Department of Public Works, Chicago; and the use of DDT in the control of insect carriers of disease, by Dr. F. C. Bishopp, assistant chief of the Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture.

Also, an outline of the proposed sewage works for the South Metropolitan District in Boston, by Karl R. Kennison, chief engineer of the Metropolitan District Water Supply Commission; a discussion of standardized plans for sewage disposal, by John R. Hoffert, assistant chief engineer, Pennsylvania State Department of Health; and a report on sanitary engineering works in Germany, by Anthony J. Fischer, sanitary development engineer, The Dorr Co., and Arthur E. Gorman, of the Federal Security Administration.

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ping division on the possible application of radar to civil engineering.

In describing pioneer work in using the short-range radar method, Lt. Carl Aslakson of the U. S. Army Air Forces revealed that it has been possible to determine from an airplane—within 0.002 miles—the geodetic distance between two points over 300 miles apart. The method also lends itself to measuring longer distances.

The second method described is the long-range procedure—commonly known as "Loran"—which was used extensively during the war for navigation of airplanes and surface ships. Planes, however seem to offer the best opportunity for use in mapping operations, because of the greater receiving range possible.

States adopt coordinate systems

A total of eleven states in 1945 formally adopted the state coordinate system for describing land boundaries, Hugh C. Mitchell, who has retired from the U. S. Coast and Geodetic Survey, reported to the mapping division. These 11 states are: Vermont, Rhode Island, Connecticut, Delaware, Georgia, Ohio, Alabama, Minnesota, Nevada, Oregon, and Washington. The new list makes 19 states in all that have passed such legislation. Massachusetts, New York, New Jersey, Pennsylvania, Maryland, North Carolina, Louisiana, and Texas approved adoption of the system before 1945. This year four additional state legislatures may act upon the proposal to adopt the system—Virginia, Kentucky, South Carolina, and Mississippi.

Structural division

Two thought-provoking papers on structural design—"Theory of Limit Design" by John A. Van den Broek, professor of engineering mechanics, University of Michigan, and "Application of Plastic Theory to Reinforced Concrete Members" by Charles S. Whitney, Milwaukee, Wis., consulting engineer—were presented before the Structural Division.

Both speakers stressed the desirability of designing structures on the basis of their maximum capacity to carry load. Mr. Whitney's theory yields design formulas that are simpler than those currently used, and produces lighter and more economical structures. In Russia and Brazil, formulas similar to those presented by Mr. Whitney are in use. It was suggested that design by plastic theory be at least permitted as an alternative to present methods.

Discussing the Van den Broek paper, Philip L. Pratley, Montreal consulting engineer, said limit design would be a dangerous tool in the hands of inexpert designers. Prof. Herbert J. Gilkey of Iowa State College, presented several arguments against the plastic theory and favored modification of present allowable stresses instead. Consensus of other speakers was that more experimental verification is needed.

Federal postwar construction

Speakers for four of the top federal agencies concerned with construction outlined to the Construction Division some of their plans and problems for the immediate postwar period.

The U. S. Bureau of Reclamation, according to Kenneth W. Markwell, assistant commissioner, is adhering to a basic policy of "utilizing to best advantage every drop of water in the West", implementing this policy by the development of multi-purpose projects on which the sale of hydro electric power aids materially in covering the cost. A great program of development in the 11 arid states and in semi-arid sections of 6 others has been proposed to Congress. Mr. Markwell emphasized the importance of the program by citing Department of Agriculture studies forecasting the necessity for bringing about 40 million new acres of land under cultivation by 1960 to replace marginal and submarginal land, to meet the needs of growing population and to supply export markets.

With respect to the postwar work of the Public Buildings Administration, Commissioner W. E. Reynolds cited the work now under way in preparing design instruction manuals setting forth the basic requirements for such structures as postoffices, federal office buildings, federal penitentiaries and the like, which it is hoped will help to speed up and improve the work of private architects and engineers hired by the PBA. The necessity for increased design efficiency was emphasized by reference to the bill now before Congress, asking for permission to buy sites and prepare plans for projects in advance of construction appropriations. This has not been possible heretofore, with the result that only relatively small planning programs could be undertaken.

In contrast to the expanding requirements of civilian agencies, Rear Admiral John J. Manning, chief, Bureau of Yards and Docks, cited the great curtailment of construction expenditure by the Navy. At the same time, the Bureau of Yards and Docks has a full program to occupy its reduced forces. This will include disestablishment of many wartime naval and air stations, the maintenance of shore facilities in the United States and the maintenance and redevelopment of bases overseas.

One of the largest activities at present is that of preparing plans for permanent bases in the Pacific, in which new construction, particularly of housing, must replace the temporary and hurriedly built wartime accommodations. The largest current project at home involves the design and construction of berthing facilities for inactive fleet units, which will be pulled out of the water and placed in grease. This work will involve expenditure of about $70 million.

Admiral Manning revealed that the

(*Continued on p.* 59)

Urban redevelopment by private initiative

M. C. Lubar, of Communities Redevelopment Corp., New York City, suggested a practicable answer to the problem of expediting redevelopment of blighted areas, speaking before the Housing Division of the ASCE.

He proposed private financing and construction within the framework of municipal housing authority laws now in force in 39 states.

Under this plan, the local housing authority contracts with a private company for the purchase of a redevelopment project. The entire price therefor is paid in revenue bonds of the authority, which are secured only by mortgage on the project. Neither the housing authority nor the city is required to guarantee these bonds or to make any outlay of funds. The housing authority, however, is required by state law to establish rents in its projects at a level adequate to provide sufficient revenue to meet all debt service requirements. The private group undertaking to deliver the project to the authority agrees to furnish about 30 percent of the funds, without which the project cannot be financed. This equity investment is returned to the private group out of the revenues of the project after prior lien securities are serviced.

Speaking on "Public Works Program in Relation to Urban Planning," George H. Field, commissioner, Bureau of Community Facilities, FWA, outlined the assistance his bureau is preparing to give on planning.

Federal agencies are finding it desirable to know the urban plans and prospects ten to twenty years ahead, partly in connection with aids and grants asked of Congress. The speaker said that communities should continue to have primary responsibility for planning and construction of their public works. He did not offer an opinion on the extent that federal aid should be used to finance local improvements.

Push Roads, ARBA Told

(*Continued from p.* 53)

gineers Mr. Upham urged that a 3-month refresher course in the basic principles of highway engineering be given by the state colleges or other educational institutions, and the student should receive proper compensation from the state highway department while in training.

Three state universities already have signified their readiness to participate in such a program, reported Mr. Upham, and others are expected to follow.

Regarding the trend of highway contractors' bids, Mr. Upham declared that no engineer should be criticized for letting contracts which do not run over 30 percent higher than 1941 contract prices. Using studies on price trends conducted by the Public Roads Administration, Mr. Upham declared that the last normal construction period was from 1925 to 1929, with 1927 being the average year.

Contract prices during 1941 were still influenced by the depression of the 1930's to the extent that they averaged only 80 percent of the average year of 1927. Using 1941 prices as the base, the 1927 average is 25 percent greater than that of the Pearl Harbor year. To this difference of 20 percent between 1927 prices and those of our last prosperous period should be added 10 percent for allowable increases in materials, wages and future uncertainties of these two factors. Thus, said Mr. Upham, an allowable increase of 30 percent over 1941 contract bids seems entirely justifiable.

Surplus equipment

There are at present less than 10,000 items of construction equipment in use in this country by the Corps of Engineers, said Lieut. Gen. Raymond A. Wheeler, Chief of Engineers. When our current hospital construction is completed, this quantity will be reduced even further. As the Army Engineers begin 1946, there is no marked quantity of construction equipment remaining on their hands in excess of their needs, which has not been declared surplus to disposal agencies, he said.

In reporting on the equipment outlook, J. T. Callaway, president of the Manufacturers' Division of ARBA, warned the assembled contractors that they may be forced to use their old equipment much longer than originally planned. Despite the many problems of reconversion, our new peace time stride is definitely in the making and by the middle of this year the development and production of construction machinery should approach a reasonable pace. The total back-order pile for new equipment is large and it may carry through to 1947, he said.

A rather pessimistic view on the amount of construction expected to be completed this year was presented by Maj. Gen. Philip B. Fleming, administrator, Federal Works Agency. Four months ago the FWA estimated the total 1946 public construction would reach $2.1 billion. Now, however, the agency expects it to be only $1.9 billion and if conditions do not improve this year's total public construction may not reach $1.7 billion.

Highway construction

In the highway construction field, declared Gen. Fleming, a few months ago we estimated the 1946 program might reach $900 million. But now this estimate has been lowered to $700 million. He expressed the fear that shortages of skilled labor rather than lack of materials might be the serious bottleneck in highway construction. Added to this, he concluded, is the general uncertainty as to future costs of labor and materials. As long as this uncertainty exists, contractors will hesitate to make fixed commitments extending many months into the future.

Pan American Award

At the association's annual dinner the Pan-American award for "Outstanding Achievement in the Development of the Pan-American Highway" was presented to Thomas H. MacDonald Commissioner of the PRA, and to Montes de Oca, president, Banco Interncional, Mexico, in ap-

(*Continued on page* 59)

New road safety design concept cited

Although the need for safer highways has been stressed by the ARBA for over 20 years, a new concept on just how traffic accidents can be reduced by better highway design was presented to the assemblage by Spencer Miller, Jr., state highway commissioner of New Jersey.

Illustrating the rapid rate of increase in recent traffic fatalities, Mr. Miller pointed out that deaths on our highways for the month of August, 1945 were 26 percent higher than those during August, 1944. In October, 1945, they were 53 percent higher than in October, 1944—and almost equal to the all-time high of October, 1941.

The highway accident problem is divided into three parts, said Mr. Miller. They are (1) safety in the mechanical construction of the vehicle, (2) regulation, control, education and enforcement, and (3) design of the highway to provide inherently safe facilities and to overcome, to as large a degree as possible, the failings and weaknesses of the driver. All three of these measures must be applied vigorously, he said, but responsibility for the third rests solely on the highway engineer.

One of the greatest contributions to highway safety, declared Mr. Miller, can be accomplished by improving existing substandard highways by widening pavements, increasing shoulder width and eliminating dangerous curves. Regarding all new construction, he emphasized the following seven-point program:

1. Separation of streams of traffic flowing in opposite directions and the provision of at least two wide lanes in each direction in order to reduce the possibility of head-on collisions and sideswipeing.

2. Elimination of all highway and railway grade crossings so that there will be no traffic lights and cross traffic.

3. In open areas the provision of wide, smooth, stable shoulders level with the pavement to enable vehicles to park completely off the paved area and to provide "elbow room" in cases of traffic emergency or mechanical failure.

4. Utilization of the "Freeway and Parkway" principle, thus controlling commercial ribbon development along the highway and preventing early loss in transportation efficiency and eventual obsolescence.

5. Exclusion of pedestrians.

6. Adequate design standards to care for present speeds and to allow for possible increased speeds in the future.

7. Provision of specially designed access and exit facilities at appropriate intervals to permit safe entry and exit to avoid traffic turbulence.

Quoting accident elimination figures compiled by the New Jersey highway department, Mr. Miller gave a concise picture of what may be expected in the way of reduced fatalities through improved highway design. In New Jersey, 21 percent of all accidents involve streams of traffic moving at right angles to each other, 30 percent from opposite direction (head-on), 11 percent from fixed objects, 10 percent involve pedestrians and 7 percent are from miscellaneous causes.

By utilizing the above 7-point improvement program these percentages can be reduced as follows, declared Mr. Miller: Right-angle, 21 percent; same-direction, 20 percent; opposite-direction, 21 percent; pedestrian, 8 percent; fixed objects, 6 percent—making a total of 76 percent less accidents on the highway. "Thus," concluded Mr. Miller, "it can be seen that improved engineering technique and design will have a pronouncedly favorable effect on accident reduction".

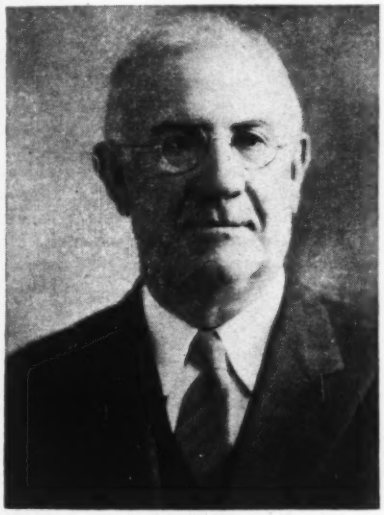
Push roads, ARBA told

(*Continued from p. 58*)

preciation of their untiring efforts in developing the project. The presentation was made by Paul Cunningham, member of the House Roads Committee. In accepting his award, Mr. MacDonald, declared that although some have estimated that the Inter-American highway will be completed in two years, he believed that it will be three years before it will be possible to drive over the highway all the way from this country to the Panama Canal.

New ARBA officers

New officers elected to serve the ARBA during 1946 are: James J. Skelly, Media, Pa., reelected president; Paul B. Reinhold, Pittsburgh, Pa., reelected vice-president of the Northeastern District; Alex F. Hancock, Mobile, Ala., vice president, Southeastern District succeeding W. A. Young, Macon, Ga., E. R. Galvin, Massillon, Ohio, reelected vice president, Central District; Robert A. Allen, Carson City, Nev., vice president, Western District succeeding C. H. Purcell, Sacramento, Calif.; and H. C. Whitehurst,



James J. Skelly reelected ARBA President

Washington, D. C., reelected treasurer. Directors for a 3-year term ending in 1949 are R. H. Baldock, Robert B. Brooks, J. F. Cast, Bernard Gray, W. W. Polk, A. R. Taylor and Nello Teer, Jr.

Charles W. Smith, Pensacola, Fla., was reelected president of the Contractors' Division; Paul B. Rynning, Medford, Ore., president, County Highway Officials Division, succeeding A. F. Ranney, Akron, Ohio; Nathan L. Smith, Baltimore, Md., reelected president of the Municipal Division; and T. J. Callaway, reelected president of the Manufacturers' Division.

Uniform effluent marks plain aeration

A process giving a definite degree of sewage treatment somewhere between that provided by primary and secondary processes is seen by Uhl T. Mann, chief operator of the Ley Creek sewage treatment plant at Syracuse, N. Y., as a result of plant-sized experiments with plain aeration.

In a paper presented before the annual meeting of the New York State Sewage Works Association in New York Jan. 18, Mr. Mann pointed out that while the final effluent was not as clear, nor the percent reduction of B.O.D. quite as large as that obtained by activated sludge treatment, plain aeration offers definite advantages for cold-weather operation.

Primary advantage seen in the process by Mr. Mann is the uniformity of B.O.D. and solids removal. Another advantage is the compactness of the sludge produced. Sludge drying beds thus can handle more effectively sludge produced during snowy weather.

Data recorded on a 6-mo. test, during which the Ley Creek plant was operated as two separate units (one returning activated sludge, the other making no return), showed that maximum economical B.O.D. and suspended solids removal was accomplished by plain aeration in 6 to 7 hr. Further aeration resulted in very small additional removals.

Discussing the paper Lloyd R. Setter, principal sanitary chemist of the New York City Public Works Department, pointed out that the Ley Creek experiment was inaugurated in an attempt to conserve drying bed space by compacting sludge. He said tests run at the Wards Island plant in New York indicated that modified aeration may be preferable to plain aeration because of the better effluent produced at little added cost.

Plant design and solids removal

Stating that percentage removal figures are not truly indicative of plant efficiencies, Thomas Riddick, consulting engineer of New York, suggested as a basis for comparison the total organic contribution made by each plant to its receiving waterway. In a paper titled "Solids Removal as Influenced by Sewage Treatment Design" he stressed that an engineer cannot control the amount and character of sewage delivered to the plant, but that by careful consideration of these factors he can more expertly fit available processes to its treatment.

R. C. Merz, sanitary engineer with the Chain Belt Co., Milwaukee, reviewed the importance of properly proportioning chambers to collect grit without settling out organic matter during low flows. To condition putrescible grit he suggested returning it to the inlet end of the chamber by means of chain-and-bucket conveyors until satisfactory washing has been accomplished.

In an illustrated talk on "Impressions on Postwar Germany" A. J. Fischer, of the Dorr Company development department, stated that in his opinion there would be no sewage treatment as such in Germany for some years to come.

Col. H. B. Gotaas, president of the Institute of Inter-American Affairs, told of the Institute's cooperative sanitation work in South and Central America.

Officers and awards

Uhl T. Mann was elected president.

No recipient of the Kenneth Allen memorial award was named, but on recommendation of the committee this award was separated into two. The second, or operators' award, will be named in honor of Lewis V. Carpenter, professor of sanitary engineering at New York University. This new award was given to Channel Samson, superintendent of sewage treatment of Tonawanda, N. Y.

Lloyd R. Setter received the Harrison Prescott Eddy award of the Federation of Sewage Works Associations for his outstanding research in modified sewage aeration.

ASCE plans expansion

(*Continued from p. 57*)

Navy will retain a nucleus of the Seabees organization in peacetime, to be used largely for maintenance, with all new construction let to contract. The Civil Engineer Corps, which, prewar, contained 200 officers, will be expanded to include from 800 to 1,200 officers.

Brig. Gen. James H. Stratton, director of the Civil Works Division of the Office of the Chief of Engineers, speaking for Lt. Gen. R. A. Wheeler, Chief of Engineers, pointed out that the program presently contemplated involves 116 flood control projects in 32 states. In addition, the Army Engineers, on the military side, will carry on a greatly expanded research program, will have the job of maintenance and development on military airbases at home and abroad, and must build facilities for our occupying forces.

The advantages to be gained by pooling the water storage facilities of regional power systems were reported to the Power Division in a paper on the Northwest Power Pool prepared by E. N. Peterson, hydraulic engineer, Ebasco Services, Portland, Ore.

Progress made in hydraulic turbine design was reported by Frank H. Rogers.

Gen. Wilby to retire, Gen. Hoge succeeds

Ft. Belvoir commandant retires Jan. 31. Brig. Gen. James C. Marshall named new president of Engineer Board

Maj. Gen. Francis B. Wilby, commanding general of the Engineer School, Ft. Belvoir, Va., and formerly Commandant of the U. S. Military Academy at West Point, N. Y., will leave his post Jan. 31, preparatory to retirement.

General Hoge

A War Department announcement said Gen. Wilby will be succeeded at Ft. Belvoir by Maj. Gen. William M. Hoge, wartime commander of the 9th Armored Division, and recently named deputy commander at the Virginia post.

Other changes announced for the top command at the Engineer School included the retirement of Brig. Gen. John W. N. Schulz as president of the engineer board. Gen. Schulz is to be succeeded by Brig. Gen. James C. Marshall, commanding general of the Boston, Mass., Port of Embarkation.

On Dec. 13, 1945, General Hoge was named North Atlantic Division engineer at Boston, but on Jan. 13, he was appointed deputy commander at Ft. Belvoir, under General Wilby.

General Hoge, a 1916 West Point graduate, served overseas in the first World War, returning to the United States in 1919. He served as district engineer at Memphis, Tenn. and Omaha, Neb., and commanded engineering units constructing the Alcan Highway from early in 1942 to Sept., 1943.

Given an overseas assignment in June, 1944, he commanded the troops that captured the Ludendorf Bridge over the Rhine at Remagen (*ENR* March 15, 1945, vol. p. 351) which gave allied armies a ten-day start in establishment of a bridgehead east of the vital river.

General Schulz, a 1908 graduate of the military academy, served in France during the first World War, and held varied engineer posts in the United States thereafter, including that of district engineer, first New York District. He joined the engineer board at Ft. Belvoir in October, 1943.

General Marshall, also a West Point graduate, served in the Panama Canal Zone, and as an engineering officer and instructor in various posts in the United States. He had been in command at the Boston embarkation port for a year.

New England flood group organizes, names officers

The New England Interstate Flood Control Committee, established to encourage closer cooperation between New England states and the federal government in carrying out flood control programs, completed its organization at Boston recently.

Formal appointment of the committee is an outgrowth of a recent meeting (*ENR* Nov. 1, 1945, vol. p. 565) of the governors of five New England states at Hartford, Conn. The governors, in a formal statement, said that the flood control committee would have two purposes: First, to permit the states some measure of control over large-scale flood control operations within their borders, and second to promote cooperation between local communities and federal authorities.

Alvin J. Parker, representing Massachusetts, was elected chairman of the new committee; Frank E. Southard, of Maine, vice chairman, and Elizabeth M. Herlihy, of Massachusetts, is secretary.

Each New England state, excepting Rhode Island, has already appointed three representatives to the committee.

Construction industry must explain position

The construction industry faces a major public relations task in explaining to the public why it can not satisfy all demands for 1946, according to Harry A. Dick, president of the Associated General Contractors of America.

Speaking before the 39th annual convention of the Illinois Contractors Association at Springfield early in January, Mr. Dick said the industry will receive much of the blame unjustly for the housing shortage, although housing represents only part of the industry.

Industry handicaps, such as labor and material shortages, must be explained to the general public, and the industry should urge that most needed work be done first, after determination by the communities affected.

Massachusetts costs up

Costs of materials and labor in Massachusetts are up 25 percent again this year, or 50 percent over 1941, officials of the state's emergency public works commission estimated in preparing its annual report.

The public works figures follow the trend recently announced by Theodore N. Waddell, state director of accounts, who revealed that high costs of labor and materials were making projects in many communities almost impossible in 1946.

NEWS IN BRIEF

In telegraphic form, here are latest news developments on the engineering and construction front during the week.

Highways—Gov. T. L. Bailey of *Mississippi* recommended that the state legislature adopt a 4,400-mi. farm-to-market road system, provide funds to match federal highway funds. . . . *Louisiana* had $8,000,000 worth of its road plans in blueprint form. . . . *Milwaukee, Wis.*, planned a $3,000,000 street paving program . . . Kentucky legislators are considering a $10,000,000-a-year rural road program. . . . Gov. Gregg Cherry of *North Carolina* said the state will spend $100,000,000 on roads in the next three years period.

Parkways, Freeways—*Pennsylvania* expects to get work on the Penn-Lincoln Parkway at Pittsburgh under way by May. . . . The State Planning Board called for *Boston, Mass.*, civic groups to support a proposal for a $50,000,000 elevated road to skirt the city's business district. . . . Work on *North Carolina* sections of the Blue Ridge Parkway will be under way in the spring.

Housing—At *Washington, D. C.*, Raymond F. Foley, FPHA commissioner, urged maximum use of existing residential structures as an interim step to ease the housing shortage. . . . The Froedert Grain and Malting Co., *Milwaukee, Wis.*, planned a housing project for its own employees. . . . Kaiser Community Homes, Inc., said it would build 10,000 two and three-bedroom houses in *California* in 1946. . . . Housing Enterprises Ltd. of *Vancouver, B. C.*, will build 300 terrace-type multiple dwelling units.

Construction—The Chicago Sun announced it would begin building its new plant—to comprise 336,000 sq. ft. of floor space—in downtown *Chicago* by early summer. . . . The Touchdown Club of *Jackson, Miss.*, plans a $650,000 stadium. . . . Crown Zellerbach Corp. planned a quick start on its $1,000,000 paper mill at *West Linn, Ore.* . . . The California Oil Co. announced plans for a $15,000,000 natural gas recycling plant near *Natchez, Miss.*

Sewage Disposal—A $1,000,000 contract was awarded to Angus Robertson Co., Ltd., to complete the main sewer in *Quebec City, Que.*, and construct a pumping station in the "lower town". . . . *Tampa, Fla.*, started engineering surveys for a $4,000,000 improvement program.

OBITUARY

Magnus Gunderson, 57, consulting engineer in Chicago, Ill., died Jan. 7 in that city. A graduate of Oslo University and the Royal Military College in Oslo, Norway, Mr. Gunderson had served as chief structural engineer of Graham, Anderson, Probst and White, Chicago consulting engineering company, from 1927 to 1938.

John F. Lyons, 48 who, for many years was connected with the N. Y. State Highway Department as assistant civil engineer in charge of the estimate department, died Jan. 8 at Rochester, N. Y.

Harold L. Odom, 28, Jonesboro, La., died Jan. 10. He was an engineering graduate of Louisiana State University, and was recently discharged from the Marines as a major.

L. Frank Kohler, 62, senior civil engineer and budget officer of the N. Y. City Board of Transportation, died Jan. 14. He had been with the board since 1925 and was in charge of the traffic research division of the engineering bureau. He was graduated from Columbia University in 1905, and was appointed to the Public Service Commission, first district, in 1910. After appointment to the commission he was employed as an engineer by that body in various capacities until June of 1919, when he was transferred to the Transit Construction Commission. On Dec. 1, 1925, he joined the staff of the Board of Transportation and had been one of its engineers since.

William Henry Miller, Stratford, Conn., retired civil engineer and formerly Stratford town engineer, died Jan. 8. He was connected with the state highway department for many years serving in the Winsted, New Milford and New Haven offices.

Clifford Cannon Cooke, 54, of Wilson, N. C., a civil engineer with the North Carolina State Highway Department, died Jan. 12.

Everett W. Olmscheid, 40, structural engineer, Portland, Ore., died Jan. 4.

Arthur R. Cope, 69, founder and president of A. Cope & Sons Ltd., construction contractors and engineers, Hamilton, Ont., died Jan. 11.

Ralph Clarke Chaney, highway planning engineer, and formerly regional engineer at Cleveland for the Ohio Highway Department, died Jan. 8 in Interlachen, Fla.

John Donald Mitsch, 48, associate professor of structural engineering at Massachusetts Institute of Technology, was killed in the Eastern Airlines transport plane crash at Cheshire, Conn., Jan. 18, in which 16 others were killed. During the war Mr. Mitsch had served as a student military adviser and liaison officer.

Wheeler N. Vorhees, 76, who retired in 1932 after 32 years as a construction engineer for the General Electric Co., died in Brooklyn, N. Y. C., Jan. 18.

Calendar of Meetings

NATIONAL

Highway Research Board, Oklahoma City, Okla., Jan. 25-28.

Associated Equipment Distributors, 27th annual meeting, Edgewater Beach Hotel, Chicago, Jan. 28-31.

American Association of State Highway Officials, Oklahoma City, Okla., Jan. 29-Feb. 1.

American Concrete Institute, 42nd annual convention, Hotel Statler, Buffalo, N. Y., Feb. 18-21.

Associated General Contractors of America, Inc., Chicago, Ill., Feb. 18-22.

REGIONAL

Colorado Society of Engineers, 30th annual convention, Shirley-Savoy Hotel, Denver Colo., Jan. 31-Feb. 2.

Wisconsin Road Builders' Association, annual meeting, Plankington Hotel, Milwaukee, Wis., Feb. 6-7.

Wisconsin Chapter, Associated General Contractors of America, Inc., and Wisconsin Constructors, Inc., joint annual meeting, Schroeder Hotel, Milwaukee, Wis., Feb. 7-8.

Ontario General Contractors Association, annual convention, King Edward Hotel, Toronto, Ont., Feb. 8.

Ohio Society of Professional Engineers, annual convention, Akron, Ohio, Feb. 14-15.

New Jersey Section, American Water Works Association, winter meeting, Hotel Roger Smith, New Brunswick, N. J., Feb. 21.

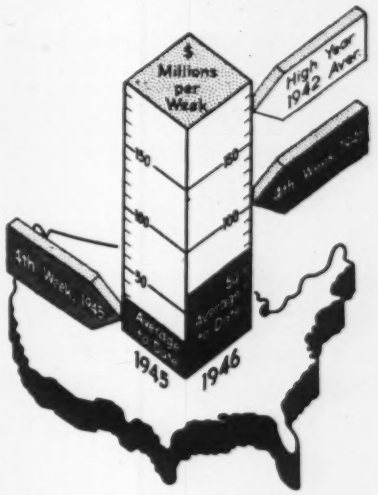
Minnesota Federation of Engineering Societies, victory convention, Hotel Radisson, Minneapolis, Minn., Feb. 21-23.

Ontario Good Roads Association, annual convention, Royal York Hotel, Toronto, Ont., Feb. 26-27.

Ontario Roadbuilding Association, annual convention, Royal York Hotel, Toronto, Ont., Feb. 27.

Michigan Highway Engineering Conference, Grand Rapids, Feb. 26-28.

CONSTRUCTION ACTIVITY



As Reported this week to ...
Engineering News-Record

CONTRACT VOLUME

Continental U. S. Only
(Thousands of Dollars)

	Week of Jan. 24 1946	Cumulative 1946 (4 wk.)	Cumulative 1945 (4 wk.)
Federal	$23,364	$36,816	$41,121
State & Mun.	13,835	56,356	14,710
Total Public	$37,199	$93,172	$55,831
Total Private	64,234	184,908	32,362
U. S. Total	**$101,433**	**$278,080**	**$88,193**

WHERE CONSTRUCTION ACTIVITY ORIGINATED THIS WEEK

Dollar Volume (Thousands)

Type of Work	This Week	Cumulative 1946 (4 wk.)	Cumulative 1945 (4 wk.)
Waterworks	$1,330	$4,011	$3,458
Sewerage	217	2,189	2,238
Bridges	1,645	8,004	3,646
Highways	8,305	27,151	8,147
Earthwork, Waterways	22,965	26,926	1,192
Buildings, Public	3,432	18,677	23,647
Industrial	28,773	78,814	24,923
Commercial	30,693	96,760	2,613
Unclassified	4,073	15,548	18,329

NOTE: Minimum size projects included are: Waterworks and waterway projects, $15,000; other public works, $25,000; Industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1946 (4 wk.)	Cumulative 1945 (4 wk.)
NON-FEDERAL	$76,458	$26,080
Corporate Securities	37,811	1,270
State and Municipal	38,647	24,810
FEDERAL	158,320	77,137
Total Capital	$234,778	$103,217

ENR INDEX NUMBERS

Index Base = 100		1913	1926
Construction Cost	Jan. '46	316.32	152.05
Building Cost	Jan. '46	242.23	130.94
Volume	Dec. '45	163	71

EDITORIALS

VOLUME 136 NUMBER 4

January 24, 1946

Wise and Welcome

ABANDONMENT ON THE PART of New York State of a plan to impose tolls on the proposed 482-mile expressway northwestward from the New York City metropolitan area will be welcomed by motorists and adjudged wise by most highway engineers. It is a tenet of sound planning for a national system of motor roads in the United States to avoid tolls wherever possible, and to lean over backward to avoid them if that should be necessary. The State of New York can readily adhere to this principle of highway development, and without any hardship. For years its taxes collected from motor car owners have been double what it has spent on its roads. Moreover, it is at present in the enviable position of being able to brag about a war-time accumulated surplus in its treasury. Under such circumstances any thought of toll roads would be as unfair as it is unsound.

Public Building Manuals

ANNOUNCEMENT by Commissioner W. E. Reynolds of the Public Buildings Administration that a series of design and construction manuals is being prepared to aid architects and engineers in handling federal building jobs has important connotations. Inherently, it suggests a desire on the part of the PBA to use private design firms on a wide scale, and a plan to make complete basic information available to all on an equal basis. Heretofore, a firm new to PBA requirements and work habits was at a disadvantage compared to one experienced in these matters, and in addition was usually a problem child to the PBA until it could be educated. There is, also, in the new plan the possibility of increasing both the speed and the efficiency of designing, with consequent lowering of costs. Without question, knowing definitely and in advance what is demanded in a postoffice, a federal office building and a penitentiary will remove one group of complicating ideas from the field of useless and time-consuming discussion, since the PBA always wins the arguments, and usually should, on the basis of its knowledge and experience in planning and operating many such buildings. There will be those who will see regimentation in the manuals — standardized instead of indigenous architecture being fostered, and inflexible structural design procedures being perpetuated; yet there is probably little ground for such fears, and certainly no basis to oppose the manuals on that score. As presently planned the manuals promise to be very useful additions to the working tools of the architect and the engineer, and a credit to the initiative and sound foresight of the PBA officials. Probably the only valid criticism is that they will not be available as soon as they should.

Recognition for Inspectors

INSPECTION, too frequently, does not attract the caliber of men needed to interpret plans and specifications properly, or to resist pressure from go-getting superintendents or smooth politicians. An article on page 79 gives some valuable suggestions for improving inspection and the professional status of the inspector. For many young engineers the first job on construction is that of inspector, for which few of them are prepared in any way in college despite the fact that nearly half the civil engineering graduates engage in some phase of construction. Practical college courses on construction-job management could emphasize better understanding and relations between the engineering and contracting sides of construction. A course in specification writing would probably give the neophyte in construction the idea that specifications are, after all, only human-made documents. But, training young engineers, or others, as capable inspectors will be of little value unless the pay rate is increased to at least the average of the workmen whose work is inspected. Yet in taking this step one qualifying condition should be observed: Unless the higher pay actually is used to obtain better qualified men, it may result in lowering standards by making inspection jobs more attractive to less desirable men.

Hope on the Labor Front

WITH STRIKES tying up three of our largest industries—steel, autos and electrical equipment—there is little room for happiness on the labor front. Yet what there is belongs to the construction industry wherein sound worker-employer agreements continue to multiply. It may well be that, unnoticed in the confusion of broader labor strife, a foundation is being laid in the construction industry for securing the improvements in efficiency and in con-

tinuity of work that are so urgently needed everywhere in our business system.

Although building wage disputes have been settled or averted in a number of cities, and only recently at as widely separated points as Rochester, N. Y. and Ft. Worth, Tex., two happenings in New York City last week serve best to emphasize that there is a basis for an optimistic outlook. One of these was the calling off of a strike of the 150,000 building and construction trades workers after the Wage Adjustment Board of the Department of Labor reversed an earlier decision and granted the men six paid holidays a year.

The important thing here is that workers, employers and government found a way not only to avert a strike but to put into effect a contract, drawn up after 18 months of study and negotiation, that provides for stabilization of hours and wages for two years at levels that are deemed fair and reasonable. The "paid holidays" merely represent a principle that everyone would like to see applied to construction, and it is to be hoped that the New York workers will deserve it by their efficiency, and be able to enjoy the continuity of employment that will make application of the principle practicable and permanent.

The other hopeful development—and one that may lead to more continuity of work in construction through the medium of lower costs—was the agreement of Local 3 of the International Brotherhood of Electrical Workers to permit and promote the use of labor saving methods and devices in the interest of efficiency in speed and costs on housing construction.

The fact that this union has been nationally known and notorious for its restrictive labor practices places its decision to change its ways in the class of a major miracle. Yet, such a circumstance should not detract from and perhaps should increase the praise that is due. The most significant characteristic of the action is, of course, the almost directly stated admission that these restrictive practices have been followed in the past, and that they have slowed down construction and increased its cost.

Similar admissions, accompanied by reform, on the part of the bricklayers, carpenters, plumbers and some others will be eagerly awaited and fervently hoped for. In the meantime the nation can enjoy the rays of sunshine already offered by the construction industry in a period of gloom, and look forward with more confidence than for some time to this great industry being able to render the service that its responsibilities of the next few years demand.

A New Bay Bridge

ANNOUNCEMENT that studies are being instituted by the California Toll Bridge Authority and the Department of Public Works looking toward the construction of a second bridge across San Francisco Bay calls attention to one of the greatest engineering successes of our generation. Decades of debate as to whether any bridge was practicable either from a construction or an economic viewpoint preceded building of the present structure. But brilliant design and skillful foundation sinking and steel erection quickly removed any doubts of technical ability, and before the bridge was two years old its financial stability was assured. Now, after only nine years of operation, the 80,000 vehicles-per-day capacity of the bridge is being approached, and the bonds will be retired by 1952 instead of in 1976, as originally contemplated.

San Francisco's Bay Bridge, like New York's Holland Tunnel and Philadelphia's Delaware River Bridge, demonstrates how well-planned river crossing facilities generate new traffic. Unlike New York's Holland Tunnel, however, where the original toll rates have been maintained, Bay Bridge charges have progressively been reduced from 65 to 25 cents. Whether they will come off entirely, when the cost is amortized, or, like the Holland Tunnel, be continued to help finance other crossings, is one of the things the new bridge planners will have to decide. They will also have to decide its location, so as to relieve the present bridge without penalizing it financially while it remains a toll structure, and so as not to affect the new bridge adversely if and when the present bridge becomes toll free. The problems of estimating traffic for 20 or 30 years in the future and of providing adequate approaches are also just as real today as they were when the present Bay Bridge was projected.

Foresight of a high order is required of the California engineers, and the results of their studies will be awaited with much interest.

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EDITORIAL OFFICES: 330 WEST FORTY-SECOND STREET, NEW YORK, N. Y

Design of Quitandinha Elliptical Dome

Arthur J. Boase
Manager, Structural Bureau, Portland Cement Assn.

***Contents in Brief**—Spanning 152 ft., a 6-in. thick, ribless, reinforced concrete dome roofs the gambling casino of Quitandinha Hotel, unique vacation resort near Petropolis, Brazil. A 2.8-in. thick concrete cone protects the dome and transmits loads to it through a multitude of hinged 6-in. square columns. Design of the dome was based on the Dischinger membrane theory. Other unusual details of Quitandinha Hotel, which was visited during the author's South American tour under the auspices of Engineering News-Record, were described in a previous issue.*

MOST INTERESTING of all the intriguing structural features of Quitandinha—Brazil's wonder hotel described in *ENR* Dec. 27, 1945—is the reinforced concrete ribless dome over the casino, designed by the theory of Dischinger as outlined in the *Handbuch fur Eisenbetonbau*, Vol. 6, 4th Edition, 1928.

This elliptical shell dome of 152-ft. span and 6-in. thickness is supported on a circular girder 2 ft. 7½ in. wide by 3 ft. 7½ in. deep. The girder in turn is supported on 24 circular columns spaced on 20-ft. 3-in. centers with the exception of the four columns at the entrance stairs leading down to the salon (Fig. 2). The spans there are 10 ft. 1½ in., 40 ft. 6 in., and 10 ft. 1½ in. Also, at this entrance the depth of the girder is increased to 5 ft. 9 in.

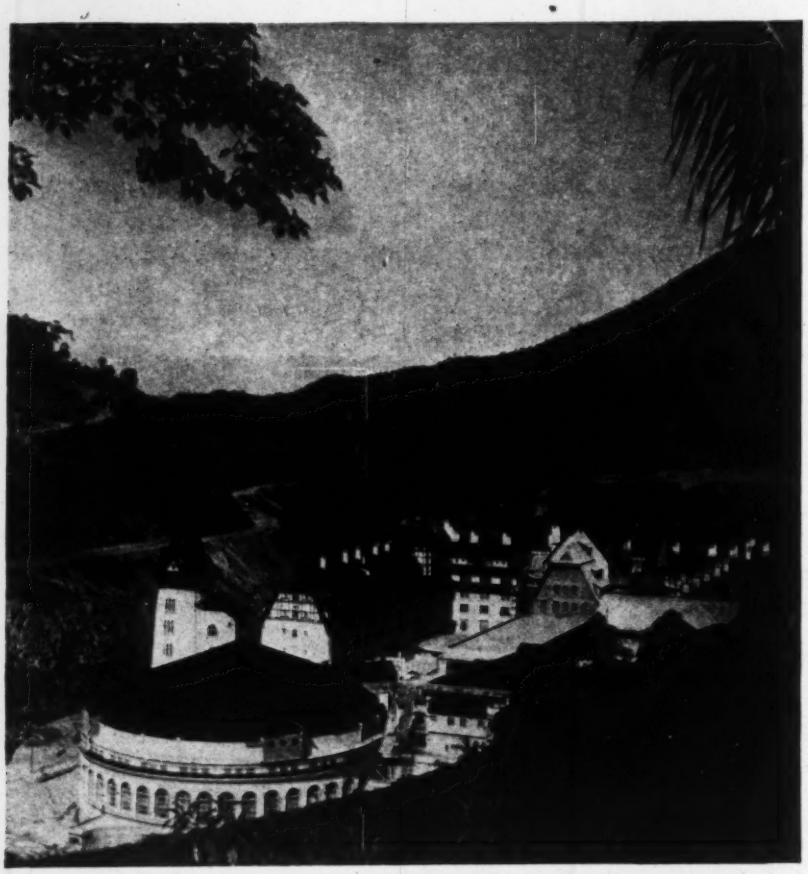


Fig. 1. Elliptical concrete dome of gambling casino is one of the most interesting structural features of intriguing Quitandinha Hotel, located near Petropolis, Brazil.

Because of architectural demands, the dome is protected by a 2.8-in. thick concrete cone, supported on a great number of 6-in. square concrete columns, which are placed close together so that the load transmitted to the dome by each column is small (Fig. 3). In this way buckling stresses of any great magnitude are avoided, and the load transferred to the dome, therefore, may be considered as a uniform load per square foot of horizontal projection.

Since these small columns were built with hinges at both ends, they cannot transmit anything but a vertical load. Consequently, the horizontal component of the wind load on the cone is taken through its rigid support to the dome periphery beam. The vertical wind component was so small in comparison with other loads that it was not considered in the final design of the dome.

Prof. Alves Noronha, designer of this structure and the man from whom the following notes were obtained, determined from preliminary calculations that a shell thickness of not more than 4 in. was necessary as far as stresses were concerned. However, because of uncertainty over the method of decentering that the contractor might adopt and the possibility of twisting or bending when the centering is struck, Prof. Noronha elected to use a uniform thickness of 6 in.

Therefore, the weight of the shell itself was taken as 75 psf. Other loads, considered as uniform load per sq.ft. of horizontal projection, were as follows:

Covering	10.7 psf.
Moving Load	21.6 psf.
Small Columns	10.7 psf.
Weight of Cone	37.0 psf.
Total	80.0 psf.

Calculation of shell stresses was made in two parts. At first the shell was considered as a membrane and, therefore, as having free or sliding supports, following the theory in *Handbuch fur Eisenbetonbau*. Stresses computed on this basis were later corrected by introducing stresses caused by the supporting ring.

For weight of dome w it can be shown that for the first part of the stress calculations the equations for meridianal thrust T and circumferential force H in the above mentioned handbook can be reduced to

$$T = \frac{wa^2}{b} \times \frac{CQ}{1-g^2};$$

$$H = \frac{wa^2}{b}\left(g - \frac{C}{(1-g^2)\,Q}\right);$$

where a and b are the major and minor axes of the ellipse, respectively, and $g = y/b$, with y the ordinate to the ellipse. Likewise for w':

$$T = \frac{w'a^2}{2b} Q;$$

$$H = \frac{w'a^2}{2b} \times \frac{2g^2 - 1}{Q}.$$

These equations were used in compiling the values given in Table I and total stresses are shown graphically in Fig. 4. The quantities C and Q may be taken from Fig. 5 when y/b and a/b are known.

The horizontal thrust transmitted to the ring by the shell of the dome may be computed as $TR_o\cos\theta$, where R_o is the radius of the parallel of latitude and θ the angle that the normal to the meridian makes with the vertical. The angle θ may be computed from the properties of the ellipse as

$$\tan\theta = -\frac{b^2x}{a^2y},$$

where x is equal to R_o at the hinge.

For the Quitandinha dome,

$$\tan\theta = \frac{(42)^2 \times 75.84}{(76.12)^2 \times 3.61} = 6.40.$$

Therefore, $\theta = 81$ deg. 7 min., $\cos\theta = 0.154$ and the thrust on the ring at the hinge equals $6{,}869 \times 75.84 \times 0.154 = 80{,}000$ lb. Since nine 7/8-in. round bars were used, $f_s = 80{,}000/5.40 = 14{,}800$ psi.

Ring stresses added

Having computed the stresses by the membrane theory, it is then necessary to determine the effect of additional stress brought about by the joining of the supporting ring and the membrane or dome proper. The type of joint used by the designer is in reality a hinge (Fig. 3). According to Dischinger, then, the stresses and deformations near the edge of the dome follow a damped trigonometric oscillating wave, with a damping factor of the form $y = e^{-k\omega}$.

The length S of arc of the curve traversed in one period is given as

$$S = R_1\frac{2\pi}{k};$$

$$\frac{2\pi}{k} = \frac{2}{\frac{4}{3}\sqrt{1-m^2}} \times \frac{\sqrt{R_2 h}}{R_1};$$

$$k = \frac{R_1}{\sqrt{R_2 h}}\sqrt[4]{\frac{3}{4}(1-m^2)};$$

where R_1 is the radius of curvature of ellipse along a meridian, R_2 the radius of curvature of a parallel perpendicular to the shell surface, m Poisson's ratio (0.114) and h shell thickness.

The radius of curvature R_1 varies along the ellipse so that k is a variable, but since in the vicinity of the ring the variation in radius is small, R_1 was assumed as a constant of 23.12 ft. Therefore, k is constant and is equal to

$$\sqrt[4]{\frac{3}{4}(1-0.114^2)} \times \frac{23.12}{\sqrt{76.12 \times 0.25}} = 4.95.$$

$$S = 6.8\sqrt{76.12 \times 0.25} = 29.52 \text{ ft.}$$

Since the damping effect is great, only the stresses in the first half of this distance are of concern.

We now need to compute the horizontal thrust H_1, which occurs at the joint of the membrane and the supporting ring. In order to find this value, we suppose that the final deformation in the shell after the application of the load due to the ring equals the deformation in the shell freely supported plus the deformation in the

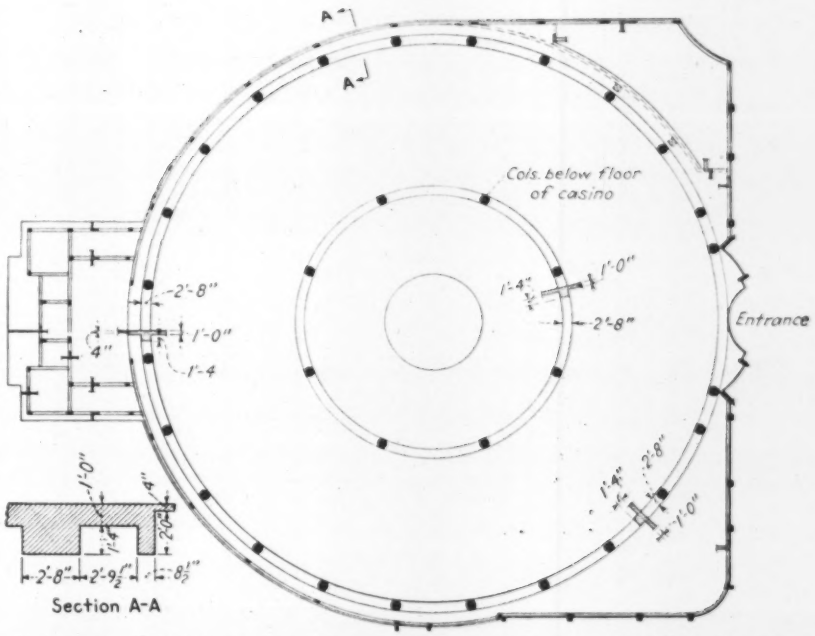


Fig. 2. Plan of circular floor of main salon showing columns supporting floor and dome. Circular girders are continuous over columns.

MAJOR NOMENCLATURE.

- T = Meridianal thrust
- H = Circumferential force
- w = Weight of dome, psf.
- w' = Superimposed load, psf. of horizontal projection
- b = Minor axis of ellipse, ft.
- a = Major axis of ellipse, ft.
- e = Eccentricity of ellipse
- y = Ordinate to ellipse
- $g = y/b$
- h = shell thickness.
- $k^2 = 1 - \frac{b^2}{a^2} = \frac{e^2}{a^2}$
- $C = \frac{1}{2} + \frac{1-k^2}{2k}\log(1+k) - \frac{g}{2}\sqrt{1-k^2(1-g^2)} - \frac{(1-k^2)}{2k} \times \log\left(gk + \sqrt{1-k^2(1-g^2)}\right)$
- $Q = \sqrt{1-k^2(1-g^2)}$
- R_o = Radius of a parallel of latitude, ft.
- R_1 = Radius of curvature of ellipse along a meridian, ft.
- R_2 = Radius of curvature of a parallel perpendicular to the shell surface, ft.
- θ = Angle that the normal to the meridian makes with the vertical
- m = Poisson's ratio, taken in this case as 0.114

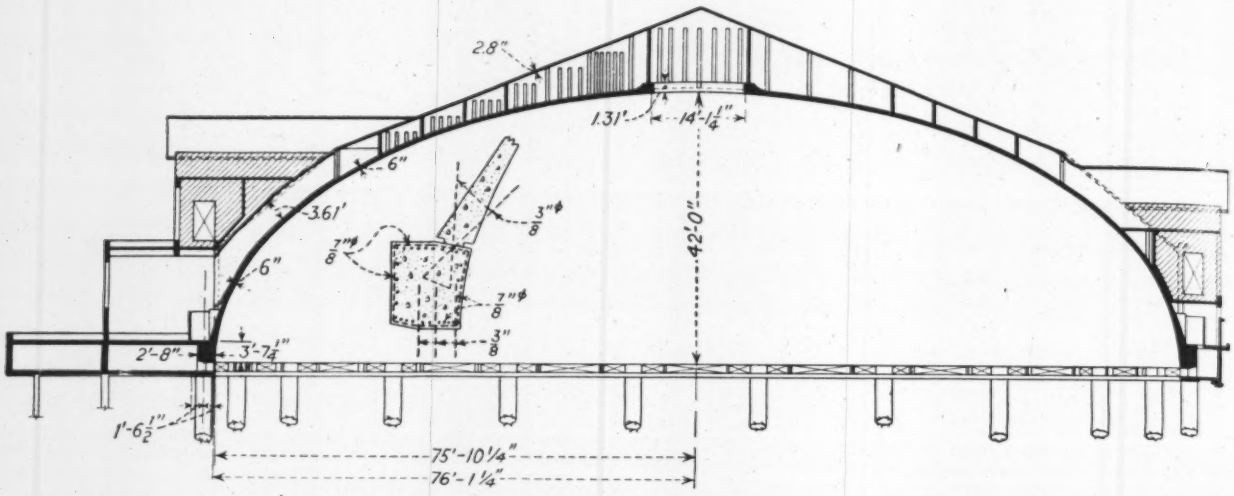


Fig. 3. Cross section through elliptical dome showing concrete protective cone and 6-in. square columns hinged at both ends.

shell due to the ring. Or, to put it in algebraic form,

$$\Delta_{SM} = \Delta_S + \Delta_{SR}$$

The radial deformation of the freely supported shell as a membrane is a function of the stress at the hinge caused by the external loads, or

$$f_{cs} = \frac{21,280}{6 \times 12} = 296 \text{ psi.}$$

and the unit deformation of the shell at the same point

$$\epsilon_{cS} = \frac{296}{3,000,000} = 1.0 \times 10^{-4}.$$

The designer assumed a rise in temperature in the dome of 27 deg. F. and also that while this rise was taking place the temperature in the supporting ring remained constant. This temperature differential would cause a relative radial unit deformation in the lower portion of the shell of $0.0000065 \times 27 = 1.8 \times 10^{-4}$ and a corresponding unit stress f_{ct} in the concrete of $1.8 \times 10^{-4} \times 3 \times 10^6 = 540$ psi. in the lower portion of the shell. Therefore, the total relative radial deformation of the lower portion of the shell due to loads and temperature rise is $(1.8 \times 10^{-4} + 1.0 \times 10^{-4})\,76.12 \times 12 = 0.255$ in.

The radial deformation of the supporting ring due to this force H_1 is

$$\Delta_R = \frac{f_{cR}}{E_c} \times 76.12 \times 12,$$

where f_{cR} is the maximum stress in the ring at the point of joining and equals

$$\frac{R_o}{A} H_1 \left(1 + 6\,\frac{e}{d}\right) = \frac{R_o}{A} H_1 (1 + 3).$$

In the above expressions A is the area of the supporting ring.

Therefore,

$$f_{cR} = \frac{H_1 \times 76.12}{1,367}(1 + 3) = 2.67 H_1;$$

$$\Delta_R = \frac{2.67 H_1}{3 \times 10^6} \times 76.12 \times 12 = 0.000814 H_1.$$

As given by Dischinger, the radial deformation of the shell produced by H_1 is

$$\Delta_S = H_1 \sin^2\theta \times \frac{k}{Eh} \times \frac{R_o^2}{R_1}.$$

The designer, as an expediency, now assumed the hinge at the bottom of the supporting ring (actually it is 3.61 ft. above this point), and therefore θ in this case equals 90 deg.

$$\Delta_S = \frac{4.95}{3 \times 10^6 \times 3} \times \frac{(76.12 \times 12)^2}{23.12 \times 12} H_1 = 0.00166 H_1.$$

Therefore, the sum of the radial deformations is

$$0.000814 H_1 + 0.00166 H_1 = 0.255 \text{ in.}$$

$$H_1 = 104 \text{ lb. per in.}$$

The radial deformation of the ring is then $0.000814 \times 104 = 0.0846$ in. That is, the ring has prevented the shell from moving outward by the amount

$0.00166 \times 104 = 0.255 - 0.0864 = 0.172$ in.

The shell at the joint is in compression and the ring in tension. On the lower portion of the shell at the hinge, the stress due to the horizontal thrust is, therefore,

TABLE I—MERIDIANAL THRUST AND CIRCUMFERENTIAL STRESS, LB. PER LIN. FT.

Angle Between R_1 and Minor Axis	Y ft.	R_o ft.	R_1 ft.	Stress due to Weight of Shell		Stress due to Load Unif. Dist.		Total	
				T	H	T	H	T	H
0	42.00*	0	138.12	5080	5080	5510	5510	10590	10590
Lantern	41.95	8.37	134.74	5073	4973	5342	5409	10415	10382
10	39.99	23.20	124.67	4959	4267	5329	4650	10288	8917
20	35.04	41.73	96.13	4603	2721	4872	2480	9475	5201
30	29.02	54.95	69.88	4301	289	4388	−309	8689	−20
40	23.06	63.45	49.38	3998	−2224	3931	−3057	7989	−5281
50	17.42	69.23	36.35	3797	−4663	3595	−5430	7392	−10093
60	12.75	72.51	30.84	3709	−7089	3333	−7445	7042	−14534
70	8.27	74.47	26.08	3629	−8816	3145	−8635	6774	−17451
80	4.07	75.79	23.79	3729	−10832	3071	−9609	6800	−20441
Hinge	3.61	75.84	23.75	3811	−11497	3058	−9781	6869	−21280
90	0.00	76.12	23.13	4065	−13238	3044	−10012	7109	−23250

* More accurately distance should have been to centerline of shell.

TABLE II—STRESSES CAUSED BY SUPPORTING RING ON DOME

$k\omega$	0	$2\pi/8$	$2\pi/4$	$6\pi/8$	π	$10\pi/8$
Distance from hinge along curve in ft.	0	3.69	7.38	11.07	14.76	18.45
f_{sR_ϕ}, psi.	+583	+188	0	−39	−25	−8
H_ϕ lb. per ft.	+40800	+13300	0	−2790	−1790	−578
f_{cM}, psi.	0	+325	+210	+68	0	−14
Moment, ft.-lb. per ft.	0	+1890	+1210	+392	0	−82

$$f_o = \frac{\epsilon_e E_c}{R_o} = \frac{0.172 \times 3 \times 10^6}{75.84 \times 12} = 567 \text{ psi.}$$

ϵ_e = unit deformation in shell due to the restraint of ring, and the total circumferential force acting on the shell, therefore, at this point is 40,800 lb. per lin. ft. Having found f_e as above, it is now possible to compute the bending stress f_{eM} along the meridian of the shell and the moment as well as the horizontal stress f_{eH_o} in the shell near the hinge. Also, the total horizontal force in the shell at the hinge due to the action of the ring over the affected distance S can be found.

Dischinger gives for f_{eM} and f_{eH_o} the following equations for the hinged elliptical dome:

$$f_{eM} = f_{e(o)} \sqrt{\frac{3}{1 - m^2}}\, e^{-k\omega} \sin k\omega;$$

$$f_{eH_o} = f_{e(o)}\, e^{-k\omega} \cos k\omega,$$

where ω = ratio of length of portion of ellipse to R_1 for various distances along the curve in the affected area. These values have been computed and are given in Table II and moments and thrusts computed from them are also tabulated and shown graphically in Fig. 6. The bending in the ring is very slight and was omitted, as was the direct thrust on the shell due to the ring tension for the same reason.

The amount of reinforcement (Fig. 7) was then calculated for stresses obtained by adding the respective values in Tables I and II.

The maximum compression given in Table I is 10,590 lb. per lin. ft., and this is less than 147 psi. on the concrete section. The designer, however, used ⅜-in. round rods up to the lantern as shown. The maximum tensile force occurs at about 70 deg. and is given in Table I as 17,450 lb. per lin. ft. Assuming a working stress of 17,000 psi., this requires a steel area equivalent to 9.3 ⅜-in. round bars per ft.

At the hinge the horizontal force (Table I) is 21,280 lb. per ft. tension. From Table II the horizontal force at the same point is 40,800 lb. per ft. compression, so the net effect in the shell is a compression of 19,520 lb. per ft.

The shell is reinforced with equal amounts of steel in the top and bottom. The reinforcing along the meridians works in combined bending and direct stress. At 3.71 ft. from the hinge, the bending moment is 1,890 ft.-lb. per ft. and the direct thrust is

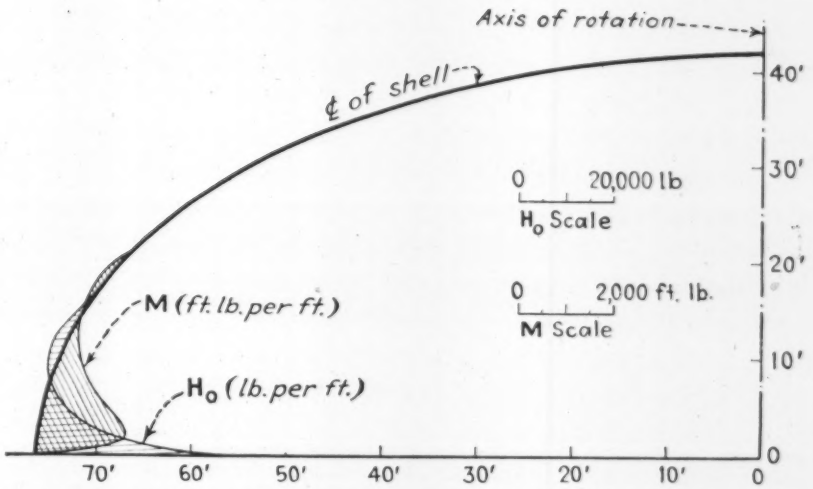


Fig. 4. Stresses due to weight of shell and uniformly distributed load are plotted radially on center line of dome assuming sliding supports.

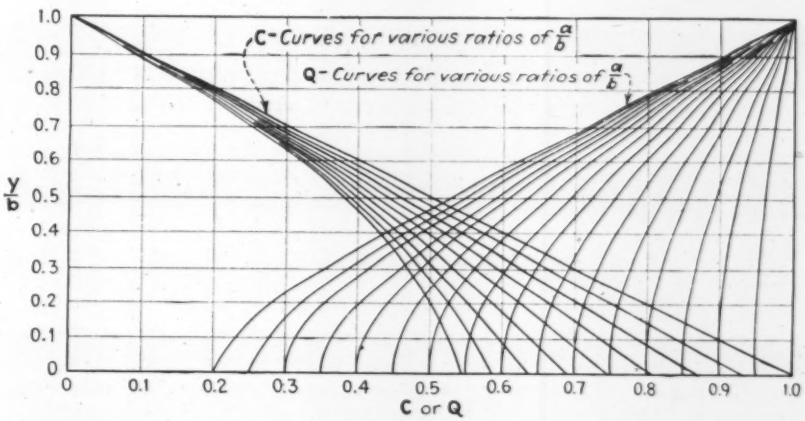


Fig. 5. Chart gives constants for substitution in membrane theory formulas for stresses in elliptical dome.

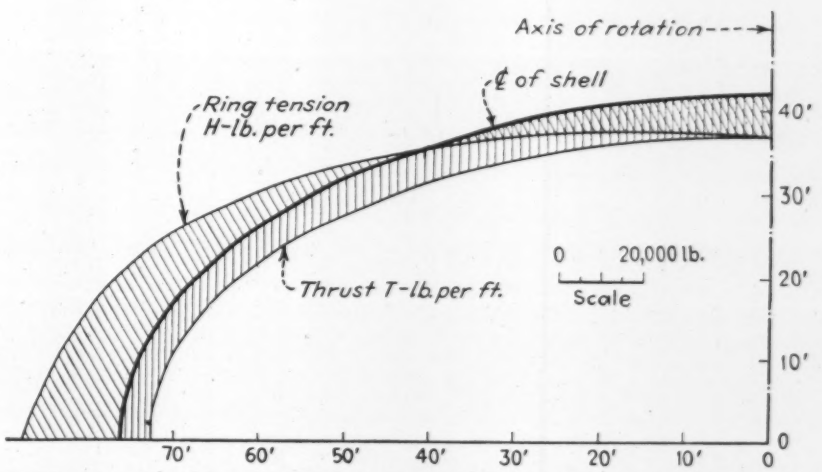


Fig. 6. Moment and thrust on shell due to ring are plotted radially on dome center line. These stresses are used to correct assumptions concerning supports.

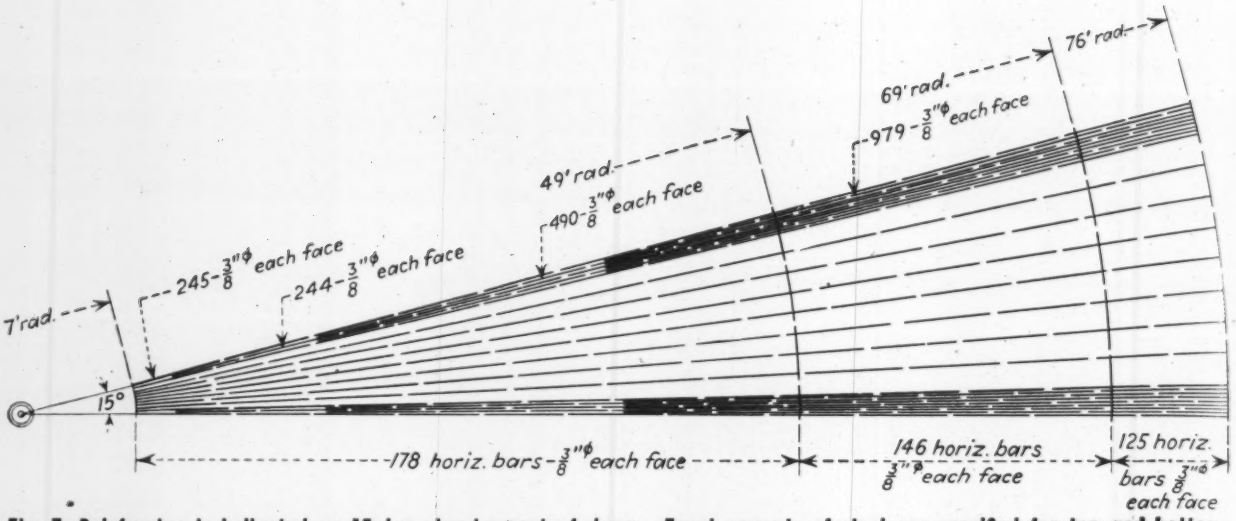


Fig. 7. Reinforcing is indicated on 15-deg. development of dome. Equal amounts of steel are specified for top and bottom.

6,800 lb. per ft. These were combined to determine the necessary amount of reinforcing.

The thrust H_1 (104 lb. per in., or 94,000 lb. total), working at f_s = 17,000 psi., requires 5.4 sq. in of steel, or nine 7/8-in round bars as before.

Centering for the dome consisted of timber posts placed on three concentric circles. The ends of the posts were set in sand boxes so that the decentering could be controlled and would be as uniform as possible to avoid bending or twisting. The centering was not removed until the entire load of the structure above the dome was superimposed and was supported directly on the dome.

Design and Construction Manuals Prepared by PBA

As part of a plan to make it possible for private architects and consulting engineers to design a larger proportion of public buildings in the future, the Public Buildings Administration is now preparing a number of manuals. The purpose of this work is two-fold: (1) to determine and assemble what PBA considers the desired practice for the design and construction of public buildings, and (2) to make this material available for architects, engineers and the construction industry in general.

The manuals are not planned to serve as textbooks. Instead, they are to set forth the standards and recommendations of the PBA based upon many years of that agency's experience. The manifold operations of the PBA has given it an outstanding opportunity to compare different designs from the standpoint of operating and maintenance costs, as well as construction and design costs.

In all, the Public Buildings Management Branch of the PBA is operating some 560 buildings with a total floor space of 78,000,000 sq. ft., requiring some 16,000 employees. In addition the agency has been in charge of the design and construction of a large number of buildings. Making this reservoir of "know how" readily available is expected to aid in reducing costs of federal building construction, as well as operation.

Eighteen different architectural and engineering planning manuals are being prepared. These are as follows: (1) Standard Details; (2) Manual of Office Procedure (Restricted to PBA use); (3) Architectural Manual; (4) Instructions for Contract Architects; (5) Design Data; (6) Post Offices and Parcel Post Buildings; (7) United States Courts; (8) Post Office Garages; (9) Offices for the Federal Bureau of Investigation; (10) Planning and Design; (typical features, such as lobbies, vaults, etc.); (11) Site Planning; (12) Architectural Materials; (13) Structural Engineering Manual; (14) Mechanical and Electrical Engineering Manual; (15) Hospitals; (16) Offices for the Immigration and Naturalization Service; (17) Offices for the Bureau of Internal Revenue; and (18) Appraisers Stores and Custom Houses.

In addition, four manuals dealing with construction are being prepared. These are: (1) Methods and Procedures; (2) Instructions to Construction Engineers; (3) Supervision of Construction; and (4) Surveys.

In preparing the manuals PBA selects a small group representing structural engineers, architects, maintenance and operating people. These groups first set up what should be included in each manual. This outline is then reviewed by a consultant group and revised if necessary as to technical content. After the manual is well advanced, that which has been prepared is again reviewed by a consulting group or committee. With such a plan preparation of the manuals would necessarily be slow. However, some are expected to be available early next year.

The work is being done with money provided in a $500,000 special planning fund provided for the PBA by Congress. W. E. Reynolds, Commissioner of the Public Buildings Administration, is in general charge.

Novel Bulkhead Pick-Up Device Eliminates Need for Diver

William E. Sidney
Principal Engineer U. S. Engineer Office
Pittsburgh, Pa.

AT MONTGOMERY ISLAND and Emsworth dams in the Pittsburgh District of the Corps of Engineers, pick-up devices, believed to be of original design, are used for handling the emergency bulkheads. Prior to the use of such pick-up devices the method of placing and removing the bulkheads or stoplogs was to manually insert a hook or attach a clevis at each of two points on the bulkhead. As the hooks or clevises were pendent from the end of the hoisting cables, they had to be attached to or detached from the submerged bulkheads by a diver. Because of the truss-like construction of the long bulkheads and the necessity of locating the lifting lugs in a position to balance the bulkhead when suspended, this work was extremely hazardous.

Design of pick-up device

These considerations caused the writer to develop special means for handling the bulkheads without the need of divers. The device, which is shown in the accompanying illustrations, consists of two 12-in. 20.7-lb. laced-channels 40 ft. 4 in. long forming a box section 14 in. wide. At each end there is a spade-shaped piece extending downward and curved inward on about a 2-ft. 6-in. radius. The tops of these pieces extend upward from the beams and are provided with a hole for permanent attachment of the hoisting line clevises. Angles attached to the outer side of the pieces locate the pick-up in correct vertical position when lowered to the bulkhead, while the inward curvature, in combination with the tapering sides of the end pieces, locates the beam in correct horizontal position on the bulkhead.

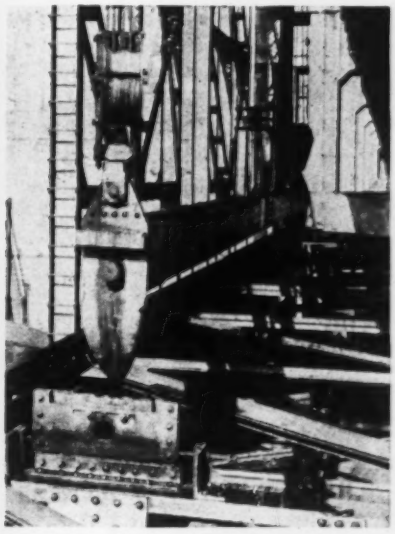
The pick-up device attaches to the bulkhead at each end by means of a 4-in. dia. pin sliding horizontally through the end plates to engage a hole in the bulkhead lifting lugs. Movement of the pins is controlled by a toggle linkage located at the mid point of the beam and actuated by a ⅝-in. dia. rope having a four-part reeving through small sheave wheels. The upper pair of sheaves are carried in a frame extending above the beam, while the two lower sheaves are attached to the toggle linkage. The frame carrying the upper sheaves also serves as a guide for the lower sheaves so that the horizontal travel of the end pins is symetrical with reference to the centerline of the device.

At Montgomery Dam, the pick-up device is suspended from an electric crane equipped with two hoisting drums so spaced that the hoisting hooks will simultaneously be located over the lifting lugs of the bulkheads. At Emsworth Dam two monorail hoists running on a single track and properly spaced by a connecting beam are used.

How device is operated

The operator in each case lowers the lifting device until the spade-shaped end piece engages and locates the device horizontally on the bulkhead. He then hauls in on the ⅝-in. hand line retracting the 4-in. pins, next "lowers" until the pick-up rests on the bulkhead and then slacks the hand line. The weight of the toggle linkage causes them to drop down, forcing the end pins out and through the holes in the lifting lugs. Until the hoisting lines are slack, the load provides sufficient friction on the 4-in. pins so that the operator cannot accidentally retract the pins and drop the bulkhead.

Editor's note: Mr. Sidney recently received an Exceptional Civilian Service Award, the highest accorded a civilian by the War Department, for development of the device described above and for other inventions.



The pick-up used to handle the bulkheads at Emsworth Dam on the Ohio River eliminates the need for a diver. Right: A 4-in. dia. pin sliding horizontally through the end plates to engage a hole in the bulkhead lifting lugs provides the attachment.

Recording Ocean Currents by Radio

***Contents in Brief**—A new current meter records automatically and continuously a series of radio-transmitted dots and dashes on a chronographic tape from which current direction and velocity can be scaled. Current surveys in Alaskan and Aleutian waters demonstrate the endurance and accuracy of the meter. Meter and buoy assembly for an unattended survey station is described.*

RADIO BROADCASTING of the strength and direction of ocean currents is regularly being done by a new current meter developed by the U. S. Coast and Geodetic Survey. The secret of the new meter, called the Roberts radio current meter, is a radio transmitter that ingeniously translates the velocity and direction of the current into a series of dots and dashes that can be tuned in by a survey vessel or by a station ashore and recorded automatically on a wax-coated chronograph paper. From the record the required current data are scaled. Several meters can be operated simultaneously in the area to be surveyed, each on a different frequency so they can be tuned in separately.

Reliability established

Operational experiments and extensive surveys on the Pacific coast and in Alaskan and Aleutian waters have demonstrated the endurance and the reliability of the radio meter. The accuracy of the meter, determined by field-calibration data, indicate a probable error for observation of velocity of less than 5 percent. Check on direction by observation at a station by ship's compass indicates an accuracy in direction of within 5 to 10 deg. Constancy of successive signals also indicates an accuracy in direction of within 10 deg. Since in strong currents the radio signals on the recording tape are quite close together, they can be scaled only to about the nearest ten deg.; directions can therefore be assumed correct to the nearest ten degrees. Experience indicates that the meter is responsive for accurate observations in currents as slack as 0.2 knot.

Meter and buoy combination

The accompanying illustrations show the meter and the assembled field apparatus for an unattended radio meter and buoy as used in the Puget Sound current surveys of 1942. The apparatus is the development from experiments during 1941 with several meter mechanisms and forms of buoys. Various units of the assembled apparatus ready for launching are shown in Fig. 1. The meter is illustrated in Fig. 2.

Fig. 1. Assembled installation for an unattended radio-meter current survey station ready for launching. A transmitter in the buoy is tuned in from a ship or shore station and "ticks" of the radiometer are registered on a tape from which current velocity and direction are scaled.

The meter is housed in a streamlined case *A* of torpedo shape suspended at a depth of about 15 ft. by a yoke *B* so as to be steady and stable in all directions. Struts *C* on the front end support the forward impeller bearing and also form a weed guard to keep the impeller free. Horizontal and vertical tail surfaces *D* and *E* stream the meter with the current and, as a preventative against excessive yawing in strong currents, a yoke leader *F* attached to the two side trunnions leads to the anchor cable. The impeller *G* has four helicoidal brass blades soldered to a conical body containing the magnetic driving element used in lieu of mechanical drive to obviate leakage. The magnetic element is made up of two identical parts, one in the impeller and one inside the meter, each composed of a soft iron armature to which is attached a set of six magnetized alnico studs. Alnico is composed of aluminum, nickel and cobalt and holds an intense magnetic charge. This unit has less than a degree of deviating effect on the compass.

Arrangement of the compass

The compass system *H*, Fig. 2, consists of two alnico needles $\frac{9}{32}$ x $2\frac{1}{2}$ in. so spaced as to have equal moments of inertia about the EW and NS horizontal axis. The compass is mounted on a vertical spindle by a gimbal with lucite Cardan ring, the center of which is $\frac{3}{16}$ in. above the compass center of gravity. Excellent balance results and the compass is substantially correct for all ordinary trim or motion of the current meter.

For surveys in the swift currents of Alaskan and Aleutian passes the usual scantling tower on oil drums, a good buoy in continental waters, failed by towing under or breaking of the ground tackle. It was necessary to design a buoy having less horizontal resistance with a planing or a lifting action derived from the force of the current. Tests of a dozen or more models

determined the form shown in Fig. 1 to be best in stability, seaworthiness and simplicity of manufacture. Besides serving as a float the buoy houses the radio transmitter.

Method of Operation

The principles on which the meter operates are briefly as follows: The meter aligns itself with the current. The impeller, driven by the current actuates through the magnetic drive the contact mechanism within the meter case which keys radio signals on the transmitter housed in the buoy. The compass mechanism consists of two sets of contact points and of a revolving contactor all arranged about the vertical axis of the compass system. One set of contact points is always oriented magnetic north by the compass magnets and the other set is fixed to the meter frame and is always oriented in the direction of the current flow.

The velocity signals are the regular radio signals keyed by the compass contact as the revolving contactor completes each cycle. In making the direction signals, the contactor closes the other set of points each *second* cycle only, thus creating a series of signals interspersed with the velocity signals.

Two sets of signals

Both sets of signals are recorded as dots distinguishable for each set, on the chronograph paper or tape. The process of "reading" the signals calls for somewhat extended description and for the explanation reference may be made to the paper from which this article has been adapted. The radio meter was devised by Lieutenant Commander E. B. Roberts, U. S. Coast and Geodetic Survey. This account of the new device is taken from a paper by Captain Gilbert T. Rude in the United States Naval Institute Proceedings for March, 1943. The address of the Institute is Annapolis, Md.

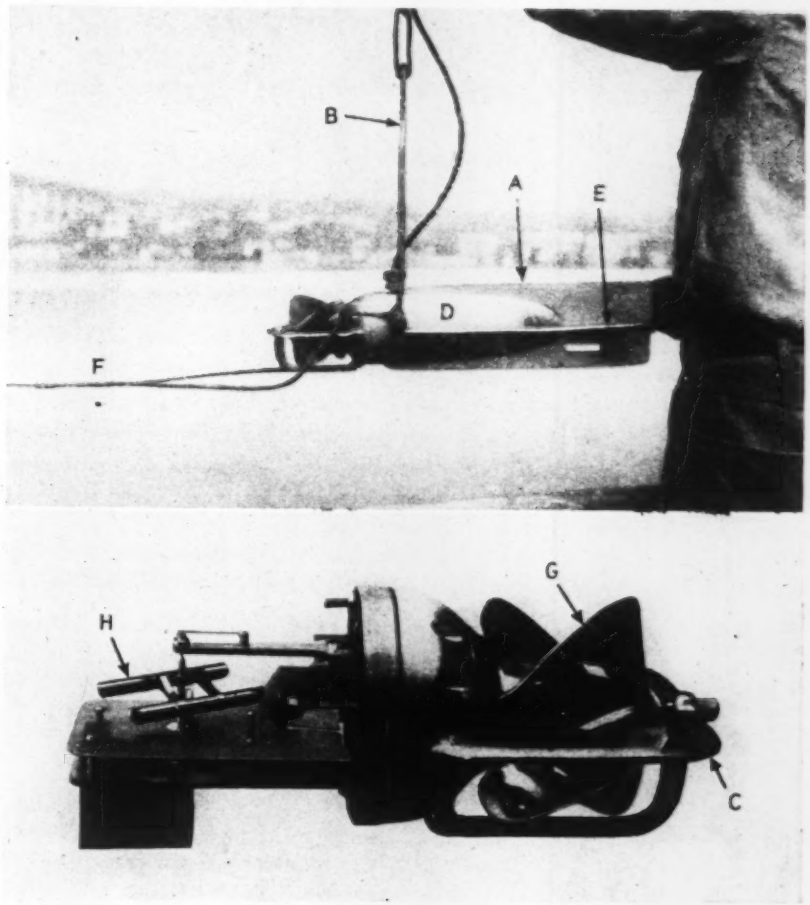


Fig. 2. Assembled meter (at top) showing yoke suspension and tailfins that stream the meter with the current. Below: Meter mechanism.

Cities Tackle Car Parking Problem

Several cities have been taking steps to alleviate crowded parking conditions in their central business districts, according to a report of the International City Manager's Association.

Detroit voters have approved construction in the downtown area of an underground garage designed to hold about 1,000 cars. The $1,816,000 project will be met by revenue bonds, which will be paid off from parking fees in 18 years.

Rochester, Minn., recently paid $124,000 for a large area that will be used as a parking lot in the business district. A parking survey is being made by Dallas, Tex., and the city is considering the lease or purchase of land that in turn would be leased to private operators for parking lot purposes. To relieve rush-hour congestion, the Dallas council recently prohibited parking on certain streets between 4:30 and 6:00 p.m.

Federal, state and city governments are cooperating in Providence and Pawtucket, R. I., in making a "parking habits survey." In Glendale, Cal., business and civic leaders have recommended that the city install parking meters and use the revenue to help pay the cost of acquiring off-street parking lots. Tentative plans to construct two 1,000-car garages in the downtown business district of St. Louis have been approved by the city's board of estimates. The city would acquire the land and downtown merchants would defray the cost of construction of about $1,000,000 for each garage.

Coos Bay, Ore., recently established two off-street parking lots to care for the all-day parking needs of employees of business establishments and has installed parking meters on business streets. Other cities that have recently installed from 200 to 500 parking meters are East Orange, N. J.; Greenville, Tex. and Oregon City, Ore. Berkeley and Riverside, Calif., are considering off-street parking lots.

Continuous Steel Girder Bridge Spans Santee-Cooper Tailrace

W. J. Gooding
Bridge Engineer, South Carolina State Highway Department

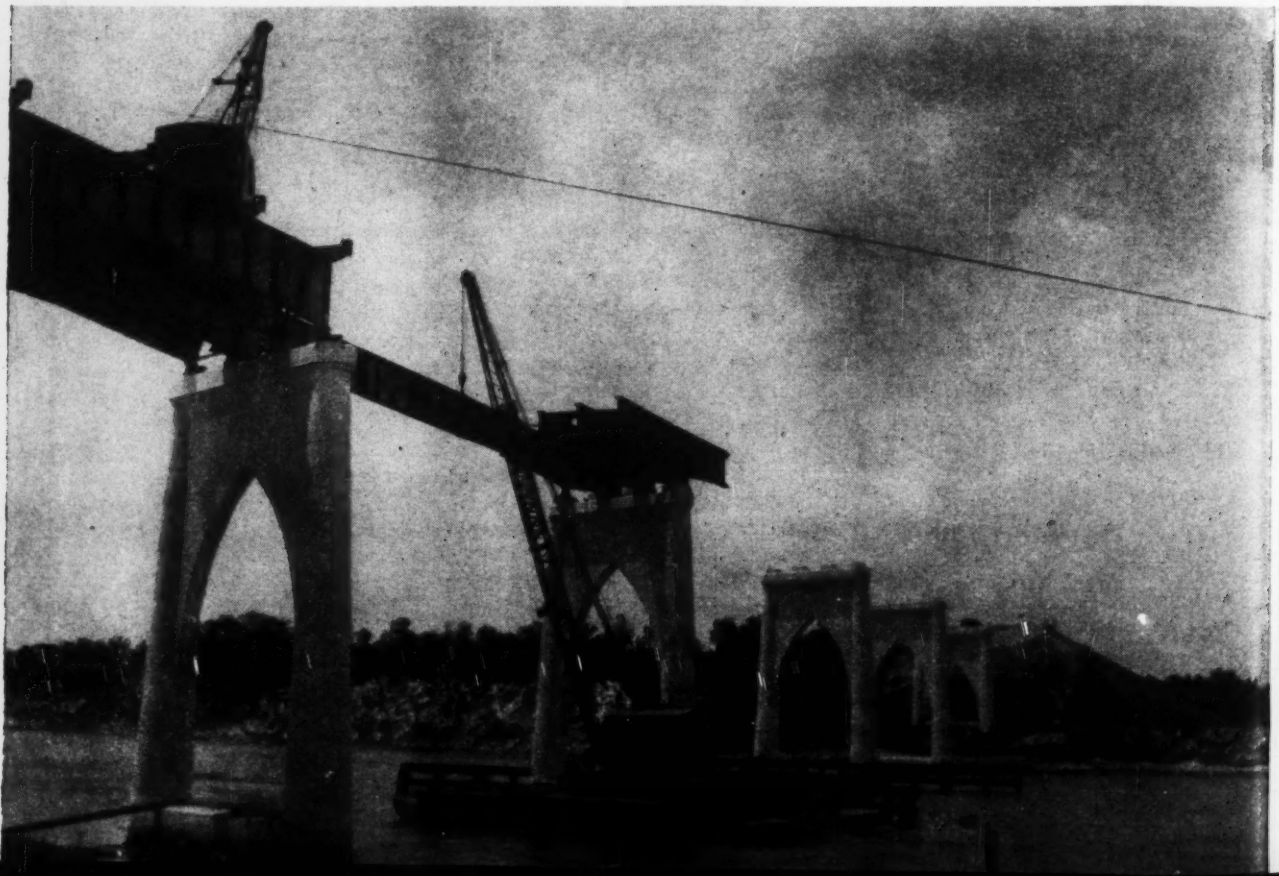
***Contents in Brief**—A continuous plate-girder highway bridge built across the tailrace of the Santee-Cooper power project in South Carolina was designed for a 20,000-psi. unit steel stress and to better accommodate the necessary skew of the piers, four lines of girders rather than two were used, floorbeams and stringers being eliminated. A crawler crane on a barge assisted by a second rig on the deck erected the 112-140-112-ft. central unit and the two-span end units eliminating the necessity for falsework.*

RECENTLY a slab-and-girder highway bridge with a three-span continuous unit over the main channel and a two-span continuous approach unit at each end was constructed on U. S. Route 52 near Moncks Corner, S. C., without the use of falsework. The design was distinguished by the use of a 20,000-psi. unit stress for the steel, individual spread footings under the two shafts of each pier, and a combination reinforced-concrete and timber handrail. The project was further characterized by the use of four lines of girders, with the roadway slab spanning between these members, rather than the conventional two-girder design with floorbeams and stringers.

Providing a 26-ft. roadway and two sidewalks, each 2 ft. 6 in. wide, the bridge spans the tailrace of the Santee-Cooper power and navigation project. The 766-ft. structure was constructed at the crest of an 850-ft. vertical curve connecting 4-percent grades on the approaches. In the two-span continuous unit at each end the spans are 100 ft. 6 in., while the three-span center portion has spans of 112-140-112 ft. The central span provides a navigation opening of 100 ft. horizontally (measured at right angles to the center line of the canal) and a 50-ft. vertical clearance above maximum tailwater.

The bridge crosses the waterway at an angle. Due to the requirement that the piers afford a minimum obstruction to flow in the canal, the structure was skewed about 26 deg. to make the long axis of the piers parallel to the direction of flow. Also, the pier shafts below high water level were connected by curtain walls so that the least frictional resistance would result, these walls giving the pier the appearance of being solid.

Fig. 1. Crawler crane mounted on a barge and assisted by a second crane on top erected the superstructure steel, the need for falsework being eliminated. The design called for four longitudinal girders.



The foundation design called for individual spread footings under each shaft of the intermediate piers. These footings rest on limestone covered by about 6 ft. of topsoil and of such consistency that it could be carved readily to the desired outline. At the bridge site, the canal, which is about 26 ft. deep with the lower 20 ft. cut into the limestone, had been excavated but not filled with water when the foundations were built. This condition permitted pier construction without interference from other than normal groundwater.

Columns tilted for stability

For esthetic purposes an arched diaphragm of the type illustrated in the accompanying photographs was used at the top of the piers. It was felt that a conventional square cap connecting the tops of the tall circular columns would lack beauty and the arch design was employed to give a better pier appearance. For greater stability the distance between the two footings of each pier was increased somewhat by using ordinary battered circular columns but with their axes tilted sufficiently to make the inside faces of the columns vertical. This procedure resulted in the outside faces of the columns being on a batter twice that of the faces located at right angles to the outside face. The layout also gave a greater distance between footings, thereby increasing stability against wind loads.

In constructing the fenders at the main channel to protect the central piers the underlying limestone proved too hard to allow appreciable penetration with timber piles. As a consequence, 10-in. 42-lb. steel H-piles were used. They were driven with a 3,000-lb. drop hammer handled by a crane mounted on a barge, and satisfactory penetration and positioning were secured. Creosoted timbers bolted to metal straps welded to the piling completed the fenders.

Each abutment cap is supported by twelve 12-in. 53-lb. steel H-piles, half of which are on a 3-to-12 batter to prevent movement of the cap toward the canal. The end fill, which is 52 ft. high above the ground line, 40 ft. wide at road level, and with 2 to 1 side slopes, had been in place for several months before the piles were driven. The contractor was allowed to drive about a 35-ft. length of pile, weld on another 35-ft. section, and complete the driving. Use of the 3,000-lb. drop hammer in this work resulted in good penetration in the limestone despite the total pile length of 70 ft.

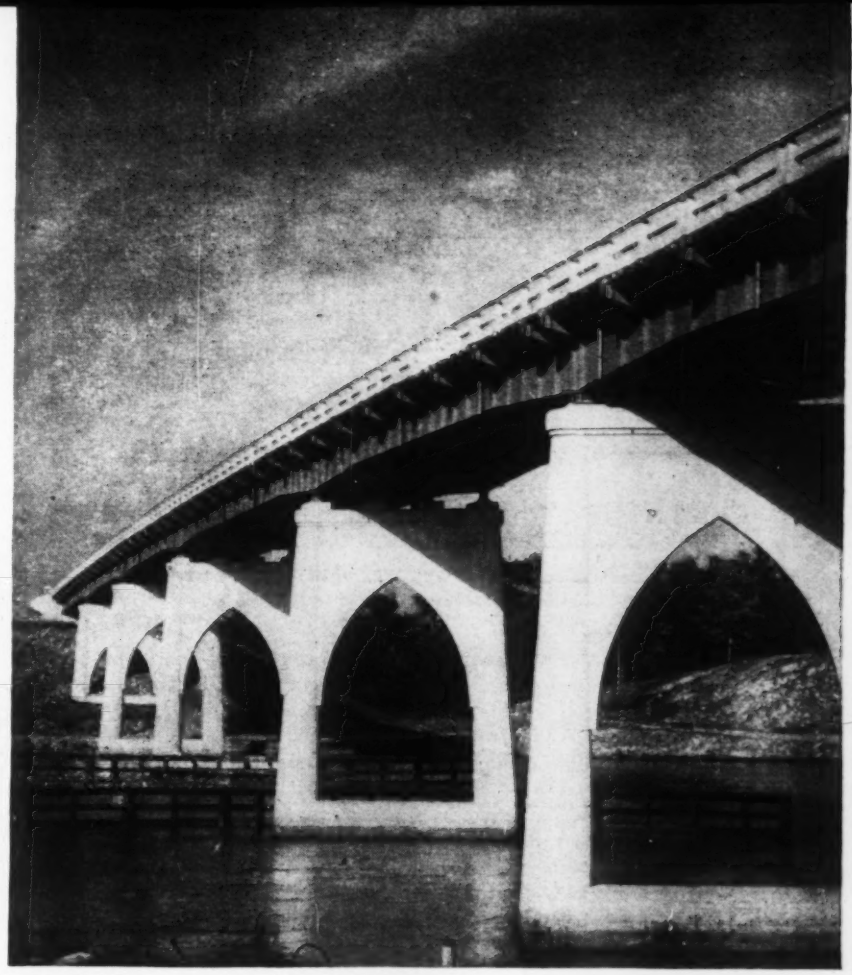


Fig. 2. Arched diaphragms at the top of the tall piers provide pleasing appearance. The pier shafts are supported on individual spread footings. Note straight-line haunch of lower flange of girders.

Four girders considered best

When the deck was designed, the skew of the bridge led to the use of four lines of girders spaced about 8 ft. on centers and with an 8½-in. thick roadway slab spanning between these members. This design was considered more satisfactory than a two-girder layout with floorbeams and stringers and with the roadway slab spanning between the latter members, which is generally preferable and more economical for plate girder bridges without skew.

In keeping with war conditions, a unit steel stress of 20,000 psi. was used in designing the superstructure, although the general design followed the 1941 A.A.S.H.O. specifications. Another exception to normal practice was the use of concrete for the lower handrail and a 6x6-in. timber for the upper rail, this departure from conventional design resulting from compliance with War Production Board directives regarding timber conservation.

For better appearance, the girder depth in the two-span units was made the same as in the longer spans of the three-span section. The girders are 5 ft. 6 in. deep generally, but increased to 7 ft. over the interior piers by a straight-line variation beginning about 24 ft. from the piers. This method of increasing the depth made the fabrication work considerably easier than it would have been with a curved variation. Also the straight lines are considered to provide equally satisfactory appearance. The girder webs are $\frac{7}{16}$ in. thick throughout, and each flange is composed of two 6x6x½-in. angles. For the 112-140-112-ft. unit only, a 14x⅜-in. cover plate is used. In addition, short cover plates are provided at the deepened sections over the interior piers.

No lateral bracing is provided between girders, but vertical cross frames spaced about 16 ft. apart tie the four girders together. All the frames are at

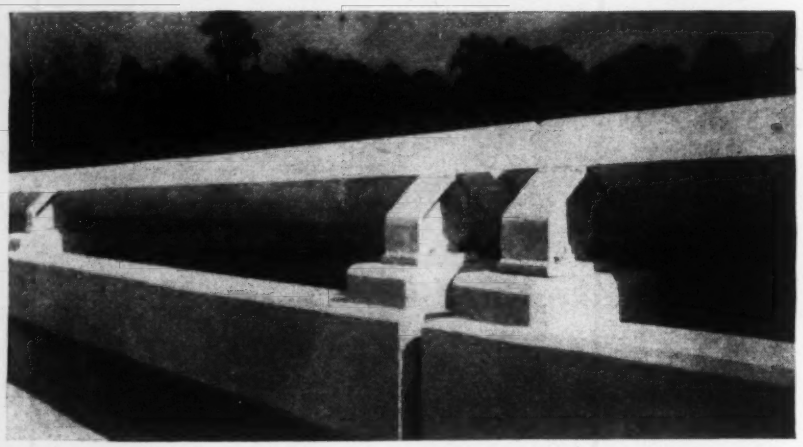


Fig. 3. To save steel, in accordance with WPB directives, a 6 x 6-in. timber was used for the top handrail, the lower rail being of concrete.

right angles to the roadway centerline except over the skewed piers, where additional frames in the plane of the piers are provided. The frames are trussed and of the full depth of the girders. The top horizontal member is a 12-in. 25-lb. wide-flange beam placed flush with the top of the girders; all other members are two 4x3x$\frac{3}{8}$-in. angles stitch-riveted together.

Use of falsework avoided

Because of delays due to war the canal was in service when erection of the structural steel was begun. To avoid the risk and expense of using falsework the girders, which were fabricated with field splices at the approximate dead-load contraflexure points for both the two-span and three-span units, were erected without falsework. This work started at one end and progressed to the other side, the operation requiring about two and one-half months.

Most of the erection work was done with a 15-ton crane equipped with a 80-ft. boom. This rig travelled on the ground when erecting the end spans and was mounted on a pontoon barge for the spans over the water. A second crawler crane of 12-ton capacity and having a short boom moved along on top as the erection progressed and assisted in raising the long girder sections.

In erecting the steel for the three-span central unit, which was the most difficult erection operation and was typical of the procedure followed throughout, the lower crane first set 55-ft. 9-ton sections of each of the four girders in balanced position on the first intermediate pier (Fig. 1). These sections were secured in place by cables extending from the ends of the members to the pier shafts at about the water line. After the four sections had been tied together by addition of the cross-frames, the two cranes erected the 84-ft. 12-ton sections to complete the first span.

Upon moving into the middle span the lower crane first erected in balanced position the 55-ft. sections over the second intermediate pier. Then, assisted by the top rig, which had moved over the first intermediate pier, the lower rig raised the 85-ft. 12-ton sections required to complete the center span. Finally, moving into the third span the barge crane assisted by the upper rig erected the 84-ft. 6-in. sections required to complete the three-span unit. During all of this work the necessary steel was delivered by truck-trailer to the bank of the canal where it was picked up by the crane on the barge and placed on the scow for delivery to the desired point. This erection procedure developed no unexpected problems, and was considered highly successful.

Because of the use of the 20,000-psi. unit design stress and four lines of girders, the lateral stiffness of the girders before addition of the deck was noticeably less than customary in highway bridge work. However, encasement of the outstanding legs of the top flange angles in the 8$\frac{1}{2}$-in. thick concrete floor slab provided the desirable lateral stiffness.

This slab was divided into sections about 31 ft. long. It was cast first at those points in the spans where the greatest deflection occurs, and the remaining pours were kept approximately symmetrical about the midpoint of each continuous unit. The final pours were, of course, made over the interior piers or at the points of greatest negative moment in the girders.

Design of forms saves lumber

The slab forms between the girders consisted of $\frac{3}{4}$-in. thick plywood panels supported on 2x8-in. joists at 18-in. centers. The joists were suspended from the girders by means of saddles constructed of No. 7 wire welded to form an elongated loop. In this work the two ends of each loop were bent down over the girder to form a loop at either side and the joists inserted in these loops, timber wedges being used to hold the forms snug to the flange angles. This method of support permitted a considerable saving in lumber at a time when this material was indeed critical.

The construction joints in the slab were located over the crossframes. To avoid the concrete diaphragm usually placed at construction joints, the 25-lb. I-beam constituting the top chord of the frame was used as support for the adjoining slabs.

What is considered an improved design of expansion joint was used between the bridge slab and the backwall of the abutments. This joint was provided with a 10x$\frac{3}{8}$-in. floating plate separated from the concrete with layers of duck soaked in red lead and secured in place at 2-ft. centers by bolts equipped with compressed springs. It is believed that this layout will provide an easy method of correcting the objectionable "slap" that frequently develops at plate-type expansion joints.

A $70,300 contract for the piers and fenders was carried out by M. L. Stephenson, Charleston, S. C. After this contract was completed, war conditions delayed for about two years the award of the $126,000 superstructure contract to McMeekin Construction Co., the steel erection work being sublet to Harvey Stuart, Charlotte, N. C.

Design and construction of this federal-aid project was supervised by the South Carolina State Highway Department under the direction of C. R. McMillan, state highway engineer, and the writer as bridge engineer. Robert S. Hills was resident engineer for the substructure work, and Salvador La-Torre for the superstructure. The Public Roads Administration was represented on the project by V. E. Towles, state representative.

New York's Airport for World Commerce

Part 1—Plan, Layout, Access and Financing

● A new pin-wheel design of runways around a central loading hub and a three-mile long arcade building that provides space for loading 104 planes at one time will give New York's new airport at Idlewild a capacity of a commercial plane landing and another taking off every 24 sec. Rental and fees are expected to pay for operations and amortize most of the investment for the $200,000,000 improvement. The unusual design and many new developments in construction will be the subjects of separate articles to appear over the next several months.

RADICALLY DIFFERENT in layout of runways and accommodations for planes and passengers, New York City's new airport at Idlewild is virtually ready for three-runway operation. When completed, twelve runways in a new tangential pattern, similar to the vanes of a pinwheel, will permit three simultaneous landings and three takeoffs with any direction of wind. A three mile-long narrow arcade structure will curlicue around a paved central hub 400 acres in extent to provide the many "gates" or loading positions required to handle a large number of planes.

The airport is located on the south shore of Long Island 13 miles east and a little south of mid-town Manhattan. Here 4,728 acres of largely marshland have been acquired and 61,000,000 cu. yd. of sand will be pumped into the low areas by the time the project is completed. Installation of drainage facilities called for the use of the most extensive wellpoint system ever made. These and other design and construction innovations lend special interest to the Idlewild project.

A ten-year program

Planned to attract and accommodate air commerce from and to all parts of the world, the airport at Idlewild is the tangible evidence of New York City's bid to retain its position as the foremost port of entry in the age of flight. It is planned on a gradual development basis to accommodate, at the end of ten years, a total of more than 300 landings and takeoffs in peak hours, equivalent to a plane taking off

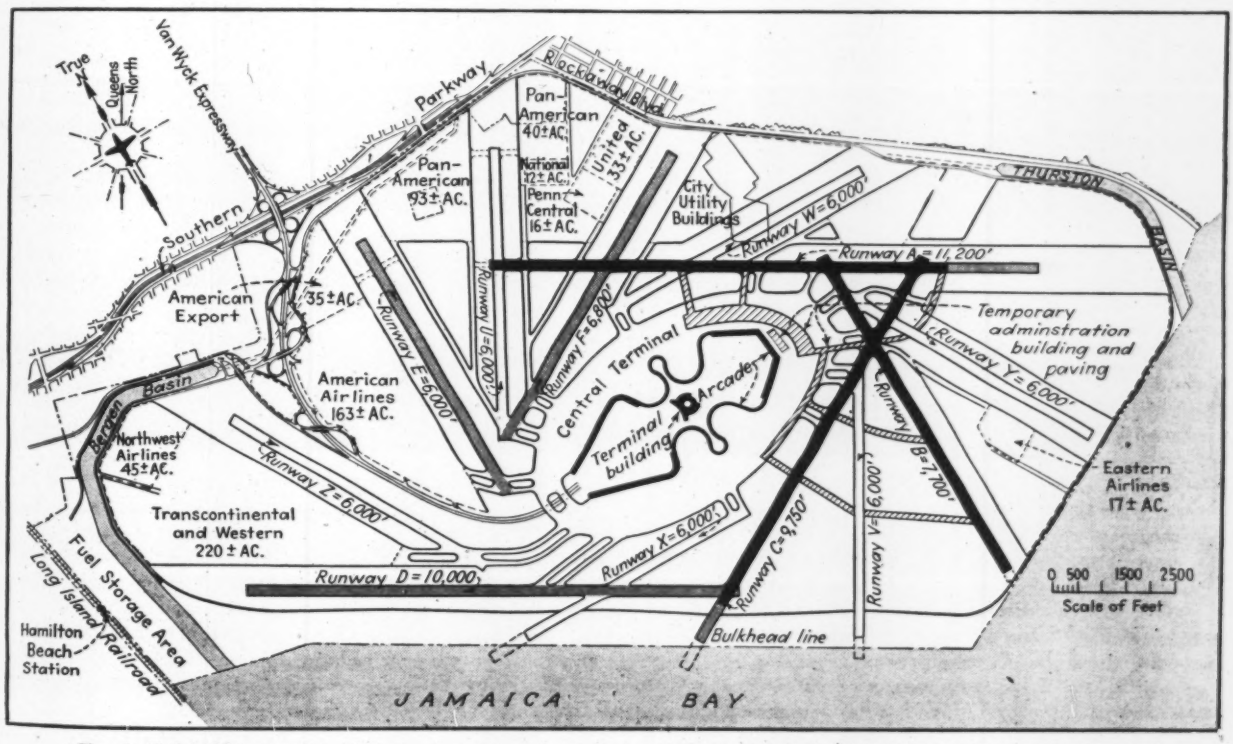


Fig. 1. Untried tangential pattern of runways is used for New York City's $200,000,000 airport at Idlewild.

Fig. 2. Temporary apron and administration building for the airport at Idlewild is located in the central hub area but where it will not interfere with permanent structures, which are to be built soon.

and another landing every 24 seconds. This compares with "capacity" operation of New York's LaGuardia Field of 400 planes per 24-hour period.

The initial stage of construction, including preparation of the field, paving three runways totaling 5 miles in length, essential taxiways and a temporary terminal building is now essentially completed at a cost of about $27,000,000. The intermediate stage, which will include three additional runways and the permanent administration building will be completed in 1949, increasing the investment to $76,000,000. The airport is foreseen as complete in 1954 at a cost of $92,000,000.

In addition, immediate construction of facilities now contemplated for individual airlines will cost $89,000,000 and it is expected that the total cost of the airport will reach $200,000,000. Flight and other fees as well as rentals are expected to make the airport self-supporting and to amortize the investment exclusive of that for permanent land acquisition and improvement.

Eight times area of LaGuardia Field

The new airport has eight times the area of LaGuardia Field, characterized when it was opened in 1940 as one of the largest and most modern airports in the world.

The twelve runways at Idlewild, each 200 ft. wide plus 50-ft. paved shoulders, will have a total length of 17 miles compared to four runways totaling 3½ miles at LaGuardia. The longest runway at the existing field is 6,000 ft., the same as the shortest proposed for Idlewild, while the maximum runway at the new port is 11,200 ft. LaGuardia Field has eight hangars, compared to the 48 of larger size provided for in the layout at the new airport site.

Some idea of the magnitude of the planned development can be obtained from the supplemental accommodations required—regular personnel of 40,000 to 50,000 persons, parking space for 30,000 automobiles, as well as a central administrative area and loading apron more than two-thirds the total size of LaGuardia Field.

On a basis of 50-place planes with 60 percent full load, some 9,000 passengers and probably 1,500 crew members could move in and out of the terminal each peak hour, though official estimates are an average of 60,000 persons using the field each day.

Despite the great size of the new field, all of the facilities at LaGuardia will continue to operate at capacity to accommodate commercial traffic, which is increasing rapidly as more planes become available to the airlines. Plans now are being made to increase LaGuardia Field in size, adding three new runways and extending the length of existing ones. It is expected that this field will be used for "domestic" flights to a maximum of 1,000 miles.

Use six runways at a time

When the new airfield is completed to the twelve-runway stage there will be a landing strip at every 30 deg. around the 360 deg. periphery. Heavy planes can land at a considerable angle to the wind so that three runways can be used simultaneously. Incoming planes land on converging runways then taxi a short distance to the central area. After interchange of passengers the planes move around to the opposite side of the field for take-off runs on three diverging strips.

This is the first time the tangential runways have been used and there is some controversy over safety in landing on converging strips. However, the airline pilots' association and the Civil Aeronautics Authority have approved the plan for this field.

Taxiways, as they usually exist, from the loading area to the ends of each runway are not used in this layout. Instead, taxiways are rather short, dual 100-ft. wide strips connecting the inner end of the runways to the apron.

Three-mile loading arcade

Entirely new in concept is the design of the central administration area and apron in the hub of the runway system. Centrally located, rather than at one side of the field, it is much more readily accessible to runways and hangars.

The administration building will be four stories high, about 500 ft. in diameter, and cover a ground area of 205,000 sq. ft. The ground floor will accommodate airlines and customs offices and provide space for air express. The lobby floor will have information and reservation desks for the airlines and concessions in a center rotunda. The second floor will accommodate general offices and has extensive observation decks around the outside. Restaurants and "hotel" rooms will occupy the third floor and the fourth floor will provide more office space. Above this will be the customary control tower.

No conventional structure, however, is adequate for loading facilities for the very large number of planes expected to use the airport. Hence the unusual arcade structure, which is in the shape of an irregular but symmetrical curve with narrow loops on two sides of the

administration center. It will have a perimeter of 15,300 ft. and will provide 104 "gates" or loading and unloading positions 150 ft. wide for airline operations. The airlines will pay $9,000 annually for the privilege of using each 150-ft. wide space. The arcade will be from 40 ft. to 90 ft. deep, the extra space in some cases being required for customs, immigration and health inspection services for international carriers.

The arcade will be two stories high. In most cases the lower floor will be used for airline baggage and space for ground crew accommodations. The second floor will have airline ticket offices, passenger lounges and space for a few concessions. The roof will be used as a paid admission observation platform, similar to that at LaGuardia Field.

Fees and concessions

Fees from flights, limousines, observation platform, parking and taxicabs as well as rentals of space at the airport are expected to bring in a revenue of $3,000,000 by 1949 and $4,500,000 in 1954. If an expected federal grant of $25,000,000 is available to reduce the amortizable public investment, estimated at about $60,000,000, the amounts received are expected to pay for operation and retire the investment in 30 years from time of completion of the airport. If the federal grant is not forthcoming fees are to be increased to amortize the difference.

About 1,000 acres of the field are allocated for hangar, parking and storage space for the airlines for which $200 per acre annual rental is charged. Hangars and arcade sections will be planned by the individual user but must be in general harmony with the other structures on the field. All improvements to be made for private use are to be paid for by the user.

Financing uncertain

Under arrangements originally worked out by the administration of former Mayor LaGuardia, the City of New York is to build and finance structures wanted by individual airlines for private use. The city is to be reimbursed, over varying periods up to 30 years, for all expenditures. Under contracts already negotiated airlines are to have a lease effective for about ten years and the right to renew leases in four 10-year increments to make a maximum period of 50 years.

Hangars, shop buildings and the like contracted for by twelve airlines are to cost about $63,000,000. Sections of the arcade planned for the intermediate stage of airport development are to cost $16,000,000, and the completed three-mile long structure more than $20,000,000.

But the incoming New York City administration, headed by Mayor O'Dwyer who took office on Jan. 1, has deleted from the 1946 capital budget the $45,000,000 fund for construction of private facilities at the airport. This was done at the suggestion of Robert Moses, commissioner of parks of New York City, who has been retained as "expediter" of building construction by the new administration.

Mr. Moses proposes an "authority" for financing the private improvements at Idlewild and thus not pledging the city's credit. The $41,000,000 in the 1946 budget for basic improvements at the airport is retained, only funds for construction of private facilities being slashed.

Much already done at Idlewild

The new airport is located largely on "made" land on Jamaica Bay just inside the city limits in Queens County. The area originally was saltwater meadows, much of it submerged at high tide. Hydraulic-pumped sand fill has been used to raise the surface of the $2\frac{1}{2}$x$4\frac{1}{2}$ mile tract to El. 16, about 12 ft. above mean high tide. The hydraulic fill was placed over about $1\frac{1}{2}$ ft. of "meadowmat," swamp hay and the like, resting on 2 to 4 ft. of mud mixed with sand and underlain with solid beach sand. Dredging was done over a $3\frac{1}{2}$x$\frac{1}{2}$ mile area of the bay adjacent to the field in a space that is a potential seaplane runway. It is not now expected that provisions will be made for seaplanes. Airlines now prefer land planes for all services, and LaGuardia is adequate for current operations.

Enormous fill job

Much of the hydraulic fill at Idlewild is complete with only 10,000,000 cu. yd. still to be placed to make a total of 61,000,000 cu. yd. Leveling of the runway areas also will require considerable earthmoving. Extensive underground facilities are required to handle the rainfall on the great expanse of the runways and some sanitary sewers have had to be carried across or around the field.

Runways A, B and C (see Fig. 1) have recently been completed and the parallel strips D, E and F are scheduled for completion in 1949. The total length of these first six runways is

COST OF LAND, FIELD IMPROVEMENTS AND CITY BUILDINGS

	Initial Stage (3 runways)	Intermediate Stage (6 runways)	Final Stage (12 runways)
Land Acquisition	$8,300,000	$10,400,000	$10,400,000
Field Improvements			
Filling	6,919,877	10,079,877	11,179,877
Grading	972,750	2,172,750	2,972,750
Drainage	1,555,000	3,405,000	4,630,000
Paving	4,599,030	14,427,805	23,164,000
Landscaping, Parking, Interior Roads	100,000	3,660,000	4,560,000
Lighting and Communication	1,582,000	3,657,000	5,612,000
Utilities	195,000	2,308,000	2,308,000
Bulkhead	.....	900,000	900,000
Boundary Fence	.....	140,000	140,000
Beach Grass	293,750	578,750	750,000
Vehicular Underpass	.....	2,000,000	2,000,000
Total	$16,217,407	$43,329,182	$58,216,627
Engineer's fees	1,054,131	2,816,396	3,783,676
Total Cost of Field Improvements	$17,271,538	$46,145,578	$62,000,303
City Buildings			
Terminal Building	$130,000	$12,800,000	$12,800,000
Power House	.....	2,600,000	2,600,000
Pumping Station	.....	600,000	600,000
Utility Buildings	520,000	520,000	520,000
Fire House, Police Station, etc	425,000	1,820,000	1,820,000
Total	$1,075,000	$18,340,000	$18,340,000
Architect's fees	25,000	960,000	960,000
Total Cost of Buildings and Equipment	$1,100,000	$19,300,000	$19,300,000
Total Cost of Field	$26,671,000	$75,845,000	$91,700,000

just under 10 miles, equivalent to 100 miles of the highest class 20-ft. pavement and an additional 50 miles of 20-ft. wide secondary surfacing.

Surface access facilities

Land access to the airport is of utmost importance for full utilization of its facilities. Considerable study has been given to the problem of transporting the expected 30,000 passengers, 100,000 visitors as well as 40,000 workers daily to and from the rather remote area where the airport is located. The only entrance planned to the loading and administration area of the airport is an express highway entering between two of the runways. The roadway is semi-depressed at the terminal entrance.

A new expressway will be constructed along Van Wyck Boulevard to take traffic from Queens Boulevard and Grand Central Parkway to Idlewild. It is estimated by planners to give 26 min. travel time for the 13 miles from Manhattan, via Queens-Midtown Tunnel, an elevated highway and a short distance on Queens Boulevard, Fig. 3. The airport at Idlewild is ten miles from LaGuardia Field but the full distance can be traversed on an express highway with no crossings at grade.

Southern Parkway lies along one side of the field and connects, westerly, through the Shore Parkway and Gowanus Parkway, to the Brooklyn-Battery Tunnel into lower Manhattan and to the proposed tunnel under the Narrows to Staten Island and New Jersey. Easterly, the Southern Parkway gives connections to all of Long Island and other parkways connect to Triborough and Whitestone bridges.

Cost of the improved roadways is not included in the airport plans and financing described above as much of it already is in approved Federal and State projects. Cost of the improvements shown in Fig. 3 are estimated at $10,000,000 for land and $30,000,000 for construction.

No direct rapid transit

Mass transportation can be provided by subways to Jamaica with transfer to buses for a five-mile trip to the airport. The Long Island Railroad can furnish service from Pennsylvania Station and intermediate points to the Howard Beach Station on the westerly edge of the airport where transfer to buses will be required to reach the terminal. The City of New York has an option to acquire this section of the Long Island Railroad and it is believed probable that it will be integrated with the city-owned subway system within a few years. It is not now contemplated that a rail line will be built directly into the airport.

It is expected, for the present at least, that most of the passengers will arrive at the airport via a fee-paying limousine from a mid-Manhattan terminal and will be taken directly to the plane-loading gate. Shuttle buses from rail transit lines probably will circle inside the arcade and some intramural bus service will be provided around the central areas and to the hangars.

Direction

The airport at Idlewild is being built under the supervision of the Department of Marine and Aviation of the City of New York. Until the first of this year the department was under the general direction of John McKenzie, commissioner, with airports under immediate supervision of Elmer R. Haslett. Since Jan. 1, Chas. R. Hoffender is commissioner of the Department of Marine and Aviation.

Planning for new connections with the City's arterial highways is being supervised by Robert Moses, commissioner of parks.

Downer, Green & Carrillo, consulting engineers have been retained by the city to design and direct construction of the airport. Associated with them are Horner & Shifrin on drainage; Edward A. Sears on electrical; Clarke, Rapuano and Holleran on access roadways; and Moran, Proctor, Freeman and Mueser on soils and foundations.

Delano & Aldrich are architects for the buildings, assisted by Weiskopf & Pickworth, structural engineers, and Syska and Hennessy, mechanical engineers.

Articles to follow in *Engineering News-Record* will deal with design and first stage construction at the airport. Features to be covered include the unusual layout of the administration and arcade structures, a revolutionary new lighting system designed to make landing possible in any weather, and a drainage system to handle water on an unusually large paved area. Construction features include high-speed paving and an extraordinary installation of wellpoints used to permit sub-aqueous construction without a cofferdam.

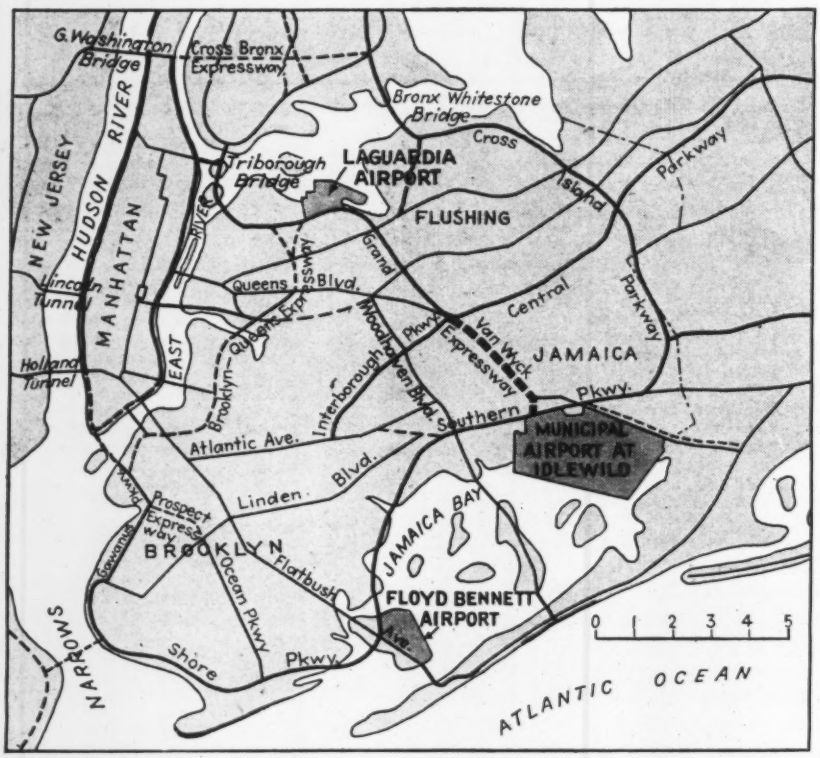


Fig. 3. Land access to the Idlewild area is afforded by a network of existing and proposed new expressways.

Why We Need Better Inspection on Construction

W. D. Bigler
Associate Structural Engineer, U. S. Navy, Long Beach, Calif.

***Contents in Brief**—Inspection on construction can be improved by (1) increasing pay rates to attract more competent and reliable men, (2) some formal training, (3) specifications written only for the particular job (4) and legislation leading to registration of inspectors as well as fixing greater responsibility on the engineers in charge. Some cities now have regulations concerning inspection but no state yet has undertaken to qualify non-professional supervisors.*

DESPITE remarkable improvements in construction theory and practice, there remains the unsolved and vexing problem of one of its essential elements—inspection. It is a paradox that supervision of construction of buildings and other structures is lagging far behind present-day engineering standards. Consideration of the many obvious faults and shortcomings of current inspection practice leads one to the conclusion that immediate remedial action will be both helpful and profitable.

When asked his opinion of current inspection standards, a building contractor with varied experience declared emphatically:

"A great number of inspectors seem to be engineers who have failed to make a living in their profession. Many consider office work too hard and, regardless of limited pay, prefer outside activity that they find easy. I believe that no more than 10 percent of the inspectors that I have dealt with are capable.

"Because of this general incompetence," the builder concluded, "contractors naturally develop a poor opinion of inspectors and are inclined to extend the opinion to all engineers."

'Inspector' is used here to mean a representative of the engineer or architect with duties principally of seeing that performance of the work complies with plans and specifications. Other designations are 'clerk of the work,' 'supervisor,' and, in higher-paid and more responsible positions, 'field engineer.'

This one contractor's criticism, however, does not consider the great number of capable and conscientious inspectors on public work who insist upon plans and specifications being executed fairly for both owner and contractor. On private work as well, some consulting engineers contend that they find no lack of adequate inspection by their field representatives.

Less pay than workmen

But such satisfactory supervision, where it is found, exists in spite of various forces that definitely invite mediocrity. The inspector's salary in many engineering organizations, for example, is relatively low, in some cases much less than the pay of a carpenter working beside him. As an illustration, the Department of Highways of Pennsylvania pays its inspectors from $1,278 to $2,328 a year. Semi-skilled men on highway work receiving as much as $1 per hr., with the overtime incident to construction (for which the inspector usually is not paid), can work half of the year and make more than the man who is expected to pass on their work.

In city and county organizations political appointees untrained for a trade or profession are often shunted to inspection crews because they can make a pretence of fulfilling their duties while standing beside a pile-driver or concrete mixer.

No formal training for inspection

A further detrimental influence is the fact that young college graduates without adequate experience frequently secure positions in this work. Though they may be ambitious and enthusiastic, these youths, as a rule, are unable to hold their own in controversies with mature and businesswise contractors where hundreds of dollars are at stake. In addition, a great many surveyors drift into inspection work although surveying has but a remote connection with construction and seldom allows opportunity for obtaining the necessary experience.

Many inspectors err by constantly bothering contractors with demands for over-careful work or with too costly interpretation of vague specifications. As an example, a hard-headed field engineer employed by a western city showed such excessive zeal that, when examining bridge handrails as they were being stripped, he would knock off any he did not like with a sledge hammer. A contractor naturally forms a dislike for this troublesome type and tends to look on all inspectors, good or bad, as troublesome.

It is more the rule, however, that the contractor encounters lax inspection and learns to expect laxness. He consequently is inclined to feel imposed upon when he finds that work on a newly-signed contract is to be checked conscientiously, especially if he has sliced 5 or 10 percent off his bid with the hope of "skinning" the job.

The greatest single fault of inspectors is failure to observe and check details. In reinforced concrete this is especially evident and especially damaging, for next to welded joints concrete requires the most careful inspection. As a rule, the field engineer and his subordinates will show an understanding of the construction project taken as a whole and will work with the contractor on his time schedule for delivery of materials and for pouring or erection. But details—alignment of forms, proportioning the concrete mix, curing—too often pass with only a hurried glance.

For example, construction drawings

of an earth-supported concrete floor usually indicate the steel mesh midway between the upper and lower faces, but when such a floor is broken into, the mesh in nine cases out of ten is found lying on the ground. As for beam-and-slab steel, rarely does an inspector measure the distance between the lower forms and bars although the position specified is fixed by bending-moment and protective-cover requirements; the familiar sight of sagging steel suspended by wire or supported by varying-sized "chairs" of broken concrete is ample evidence of indifference.

Engineers might help

At times the structural engineer shares the fault of a careless inspector by not watching the work through to the end when his help obviously is needed. On being questioned about the strength of a recently-poured upper floor of a two-story warehouse extension, the engineer who had drawn the plans said that he believed the straight, negative steel bars were missing, at least they had not been placed just before concreting started when he looked over the job. The engineer then left, believing that the missing bars were "none of his business."

It is inconsistent that a set of construction drawings, whose soundness the law attempts to assure, be turned over to an inspector of unproved ability. In all but two states today construction plans not covered by the provisions of city or other applicable building codes must be made under the supervision of a registered engineer or architect who has qualified by presenting evidence of his ability. A further assurance of safe design, common in most offices, is the procedure of having a second engineer check structural drawings for correct mathematics and standard practice.

After all these precautions the plans too often are placed in the hands of an inspector who may not be qualified to interpet them or see that they are followed and whose work is not checked. As a result, the structural engineer upon visiting the job often finds that the inspector has allowed serious unauthorized changes such as the omission of a part of a footing or substitution of a smaller-sized structural member.

It is true that state laws regulating licensing of professional engineers attempt to enforce higher standards of inspection as well as design by providing that only a registered engineer may engage in the responsible supervision of construction involving engineering. But this law has a weak point —there is nothing to force the registered engineer who is legally in responsible charge to visit the job or even to take an interest in the progress of the work. On the general run of projects that are not extensive or active enough to justify a full-time registered construction engineer—and such jobs are numerous—the engineer in charge usually remains in the office, too busy to follow details of steel erection or pouring of concrete in the field. Thus the inspector finds that, regardless of laws, he must assume the responsibilities of an engineer in making minor changes in the structural plans if he thinks unforeseen conditions justify it. He must at times, for the same reason, interpret plans that are ambiguous and decide between possible courses when the plans show a discrepancy.

If inspectors are to be delegated such authority, even though unofficially, a careful examination before employment is of vital importance. To attract only high-caliber men the examination should be limited to those who, first, show a satisfactory record in construction experience or have an engineering education and, second, give evidence of industry, honesty, and sufficient mental stamina to represent the interests of the owner in controversies that are sure to arise over the performance of the work. Since contractors' superintendents are quite commonly chosen for forceful personality and ability to handle stubborn men, the inspector, who is called upon to oppose constant pressure to decrease expenses, requires a determined, fighting spirit.

Specifications share blame

The entire blame for faulty inspection, however, cannot be placed on the shoulders of field engineers; specification writers are at times responsible. The common practice of copying specifications from the contract of the job before and of overstating requirements with the expectation that the field engineer will disregard sections not applicable makes the interpretation of the specifications a difficult task.

Especially do such carelessly-worded contracts tend to confuse the meticulous type of inspector who believes he must carry out all specifications word for word. For inspectors to perform their duties efficiently it is imperative that detailed specifications be carefully written and that they include only clauses that actually apply to the work at hand. If the specification writer and the structural engineer were to get together in the office beforehand and decide on carefully-worded clauses the inspector would not find it necessary to make so many engineering decisions in the field.

On the matter of raising the standards of inspection, several cities have passed ordinances requiring full-time supervision on certain classes of construction by inspectors who have qualified with the city building department. Los Angeles, for example, requires a full-time registered inspector on all concrete work, masonry, welded steel, fire-resistant plaster, and structural plaster, unless unit stresses are reduced as specified. In Philadelphia the owner of a reinforced-concrete building under construction must employ an inspector who has demonstrated his ability to the chief of the Bureau of Buildings.

Registration needed

No state, on the other hand, has taken legal steps to provide similar registration of nonprofessional supervisors except in the case of civil-service laws. It is true that regulation of professional and other specialized workers is justified only when the public welfare requires such a drastic step. But if licensing any group of specialists is justifiable, surely present unsatisfactory conditions warrant the licensing of inspectors. The expense of examining applicants and of checking performance of duties for incompetance and dishonesty would be largely borne by application and annual renewal fees.

A further aid in solving the problem lies in tightening the existing state laws relating to responsibilities of registered professional engineers and architects. These responsiblities must be expanded to place upon every engineer and architect who employs or supervises inspectors the charge of selecting only capable men and seeing that they perform their duties properly. Under this plan, employing an

incompetent inspector, permitting such a man to remain on the payroll, and failing to give proper instructions to an inspector would be declared justification for suspension. State boards entrusted with enforcing laws enacted or amended for this purpose would need to include in their personnel sufficient investigators to visit and study construction projects and fix blame for improper supervision.

Subjecting inspectors to strict control will eliminate incompetents and attract capable construction men. The responsibility for providing and enforcing this control rests solely with the civil-engineering profession. Engineers alone can be expected to take the interest necessary to remove the stigma from inspection and impart to it the dignity it deserves.

New Definition of Engineering Offered for Adoption

During the past year, new definitions of "professional engineer" and of the "practice of engineering" were considered by the principal engineering societies of this country. If agreement can be reached, the model registration law definition will be revised accordingly.

Representatives of the societies met at a conference in New York on August 28, 1945, under sponsorship of the American Society of Civil Engineers to study proposed revisions in an attempt to see whether a more exact definition could not be written, which might be found acceptable to courts called upon to pass upon registration laws. The conference succeeded in agreeing on definitions to be recommended to the societies for adoption.

These definitions now are being submitted to the governing boards of the several engineering organizations that participated in the conference. They were approved by the Board of Direction of the American Society of Civil Engineers at its October meeting last year.

Old definition too inclusive

Need for better definitions of professional engineering than those commonly used in registration laws for engineers was indicated by the 1944 decision of the Illinois Supreme Court declaring the new engineer license law for that state unconstitutional (*ENR*, Dec. 28, 1944, vol. p. 846). The Illinois court characterized the definition of professional engineering in the registration law for that state, which was taken verbatim from the model registration law, as so all-inclusive as to be no definition at all.

The model registration law definition that was so sharply criticized by the Illinois Supreme Court reads as follows:

"The practice of professional engineering within the meaning and intent of this act includes any professional service such as consultation, investigation, evaluation, planning, design, or responsible supervision of construction or operation, in connection with any public or private utilities, structures, buildings, machines, equipment, processes, works, or projects, wherein the public welfare, or the safeguarding of life, health or property is concerned or involved, when such professional services require the application of engineering principles and data."

The August conference in New York wrote two definitions, one for the term "professional engineer" and one for "practice of engineering." These were the outcome of consideration of numerous definitions submitted by individual members of the conference or by state boards, including the definition written into the new law passed in Illinois since the old law was declared unconstitutional. The latter states that a person practices professional engineering within the meaning of the act who plans or designs the physical parts of a long list of specified structures and facilities. (*ENR*, July 12, 1945, vol. p. 37).

New definition subject to adoption

The new definitions put forward by the conference for adoption by the constituent societies are given below.

In writing these definitions the conference members decided to abandon the expression "professional engineering" as being illogical, on the ground that engineering is a profession. However, the adjective "professional" was retained before the word "engineer" to emphasize the difference between the engineers to whom the act applies and persons commonly characterized as locomotive engineers, operating engineers, etc.

"Professional Engineer—The term professional engineer within the meaning and intent of this act shall mean a person who, by reason of his special knowledge of the mathematical and physical sciences and the principles and methods of engineering analysis and design, acquired by professional education and practical experience, is qualified to practice engineering as herein defined, as attested by his legal registration as a professional engineer.

Practice of Engineering—The term practice of engineering within the meaning and intent of this act shall mean any professional service or creative work requiring engineering education, training and experience and the application of special knowledge of the mathematical, physical and engineering sciences to such professional services or creative work as consultation, investigation, evaluation, planning, design, and the supervision of construction for the purpose of assuring compliance with specifications and design, in connection with any public or private utility, structure, buildings, machines, equipment, processes, works or projects.

Engineer as defined by this act

A person shall be construed to practice or offer to practice engineering, within the meaning and intent of this act, who practices any branch of the profession of engineering; or who, by verbal claim, sign, advertisement, letterhead, card, or in any other way represents himself to be a professional engineer, or through the use of some other title implies that he is a professional engineer; or who holds himself out as able to perform, or who does perform, any engineering service or work or any other professional service designated by the practitioner or recognized by educational authorities as engineering."

Captain Cook Graving Dock at Sydney

Maurice W. Mehaffey
Chief, Dock Construction Section
Australian Department of the Interior
Sydney, Australia

***Editor's Note**—Stated to be Australia's greatest single engineering achievement, the graving dock recently completed at Sydney is comparable in size to those anywhere in the world and will accommodate any ship afloat. The dock and appurtenant works were built in the dry inside a 33-acre cofferdam built of rock and clay with a single line of sheetpiling at its center for a head of 75 ft. of water. Concrete, made with low-heat cement, was placed in alternate monoliths for the floor; in the walls, 5-ft. sections were filled in, after 40-ft. lengths had taken their early contraction. A narrow gage railroad delivered concrete to a telpher transporter for final distribution in the structure.*

A graving dock large enough to accommodate any ship, with appurtenant wharves, material-handling equipment and workshops, is now in service at Sydney, built by the Australian government for defense of that country and the British Empire. It was planned, in 1939, to supplement facilities existing in Durban, Singapore and British Columbia to permit the Royal Navy to operate freely in any part of the world.

The new facility is located between Potts Point and Garden Island in Sydney Harbor. It is near the existing Royal Navy base, protected by established fixed defenses. It is in a first-class harbor adjacent to the highly developed industries of Sydney and near the steel centers of Newcastle and Port Kembla. Sound rock was available for foundations at a reasonable depth.

The dock is constructed of mass concrete, founded throughout on rock, and was built in the dry inside a cofferdam. The completed dock measures 1,177 ft. from the cope at the entrance to the cope at the head of the dock, with a width at entrance of 147 ft. 7½ in. and a depth over the sill of 40 ft. 6 in. at low tide. The level of the dock cope and the area around the structures reclaimed for workshops and the like are generally 10 ft. above low water. Normal tide range is about 3 ft. with a maximum of 6 ft.

Outside the dock basin an entrance bay is formed by wharves, 360 and 486 ft. long, respectively, approximately parallel to the dock centerline and about 400 ft. apart. A fitting-out wharf nearby is 860 ft. long, also of heavy reinforced concrete construction.

The floor of the dock has a level strip 20 ft. wide along the center, then slopes each way from this to the sides, at a fall of 6 in. in 49½ ft. The walls are of gravity section, generally 41½ ft. wide at the base, stepped in to 13 ft. 7 in. at the top. Four continuous altars are provided at intervals up the wall, in addition to the bilge altar and steps

Fig. 1. Captain Cook graving dock at Sydney, Australia, which was built in the dry inside a 33 acre cofferdam. Two caisson gates were erected at left inside the cofferdam and floated as the cofferdam filled.

All photos by Allied Works Council

at the base as shown in Fig. 2 and 3.

Within the walls, two subways or utility-line galleries extend entirely around the dock. The upper one carries fire, freshwater and compressed air mains, as well as cables for operation of valves and for supply of electrical services. Branches are taken through the walls at intervals to service connections at the cope and to installations in the dockyard. The lower gallery accommodates a 21-in. dia. saltwater main for supply to ships in the dock. A cross gallery, under the floor of the dock below the entrance sill, connects the subways on each side and provides a route for electric cables and service mains.

A filling culvert on each side of the dock discharges into the basin through sumps in the edge of the floor, one just inside the main entrance sill and one behind the intermediate sill. The same sumps and a portion of the culvert are used for dewatering. As all pumping equipment is located on one side of the dock, the sumps on the opposite side are connected by 4-ft. dia. culverts in the floor.

Floating caisson gate

Three grooves, formed in granite blocks, have been provided in the dock for floating caisson gates. There is an outer (emergency groove), and a main groove at the entrance of the dock and an intermediate groove about one-third of the length from the entrance. The clear length available inside the dock, with a caisson in the emergency groove, is 1,134 ft.

To facilitate the lengthening of the dock, should it ever become necessary, the side walls are prolonged past their intersection with the head of the dock. This inner end wall of the dock is founded not on rock but on top of the end units of the concrete floor.

The intermediate groove enables the dock to be divided into two sections, the inner one of 700 ft. and the outer 395 ft. clear length. The arrangement of valves for filling and emptying is such that each section can be used independently of the other. All grooves have inner and outer faces so that water may, if necessary, be impounded within the dock to a level above that of the water outside.

Two floating caissons are provided, each 151 ft. long, 37 ft. wide and 52 ft. deep, with a displacement of 3,655 tons at light draft of 33½ ft. They are

Fig. 2. The graving dock basin is 1,177 ft. long. The auxiliary caisson groove in the foreground makes it possible to divide the dock into two sections with effective lengths of 700 ft. and 395 ft.

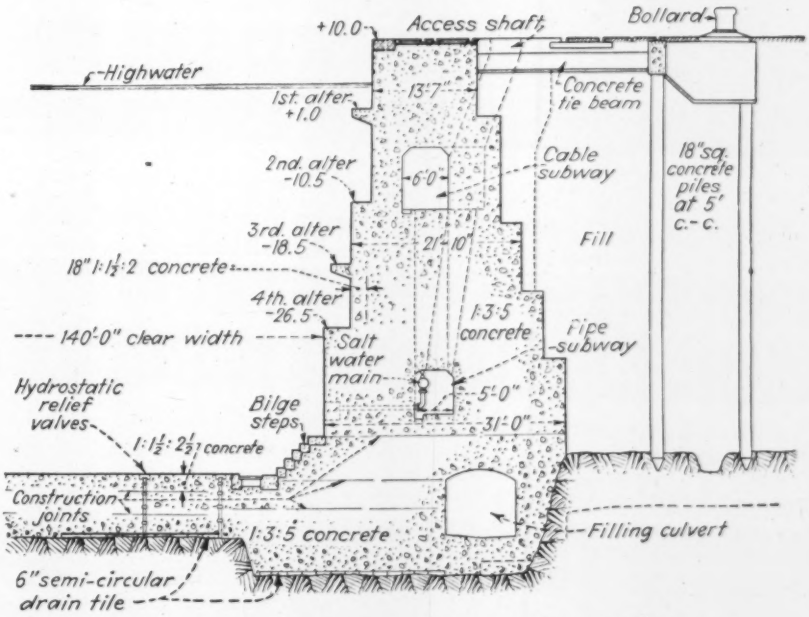


Fig. 3. Lean mass concrete to minimize heat of hydration and rich face concrete for greater durability were used in both the sidewalls and floor of the dock.

all-welded steel construction, bolts or rivets being used only for attachment of armor plating. The sides are protected above water level with 1½-in. armor plate and a 4-in. armor plate deck is provided, which is covered with wood-block paving.

The stem and stern of the caisson gate are built with a slope of 8 to 1, as are the grooves in the walls, so that when floating light a caisson has adequate clearance for handling into the grooves. When sunk in place there is about 10-in. clearance at each end, tapered timber blocks being used to insure accurate centering.

Each caisson has a 16-ft. dia. cylindrical water-ballast tank running fore and aft, divided into three compartments to adjust trim. Tidal chambers

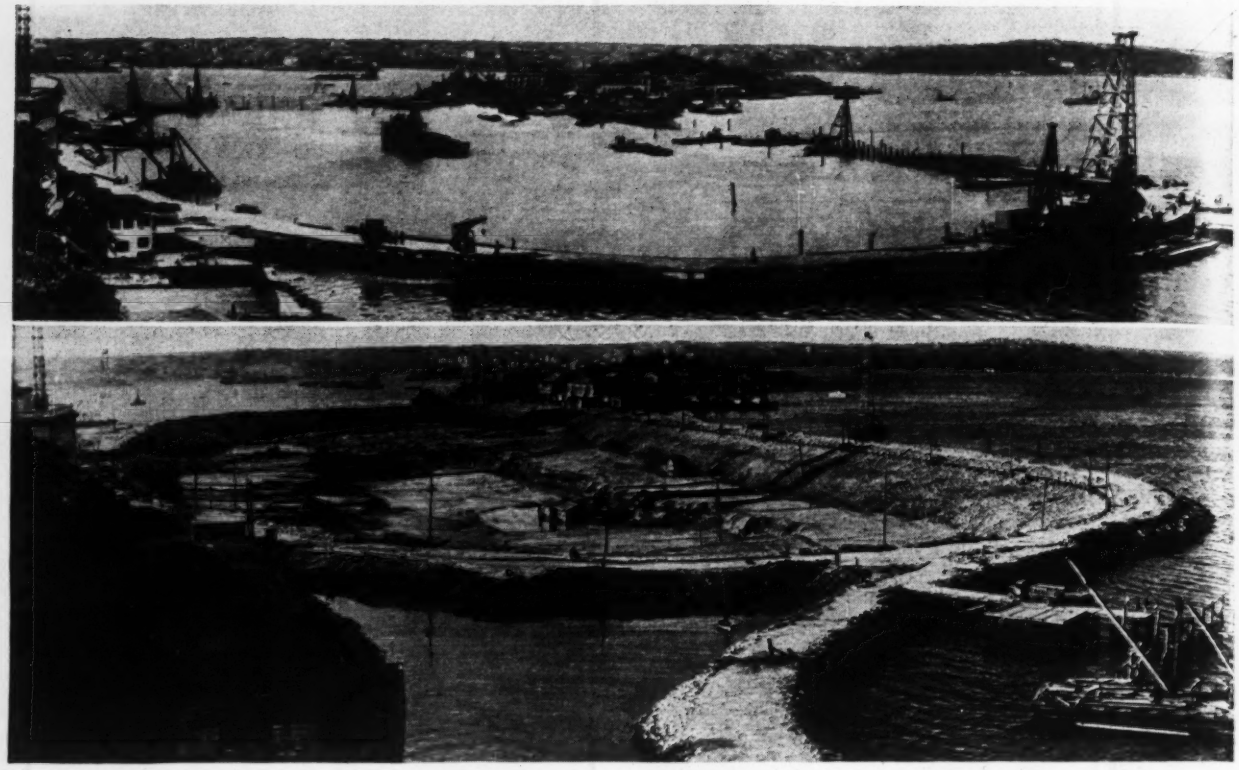


Fig. 4. A rock-protected clay-filled cofferdam with a single line of sheetpiling at its center withstood a 75-ft. water differential.

are provided on each side of the gate above normal water level, separated by a longitudinal bulkhead.

When the caisson is sunk, water is first admitted to the ballast tanks. This brings the inlet valves to the tidal chambers below external water level. The inlet valves are opened and the chambers flooded. The caisson then sinks until the tidal chamber valves are closed. When raising the caisson, water in the ballast tanks is blown out by compressed air, while the tidal chamber valves are left open to allow the water to flow out.

Three main pumps

Main pumping equipment for the dock is concentrated in an underground house located in one of the walls near the outshore end. The pumphouse is a reinforced concrete structure 140x40 ft., built mostly in rock excavation, with special protection against bombing. There are three main pumps of the horizontal spindle, centrifugal type, with 60-in. dia. suction and 54-in. discharge, driven at 272.7 rpm. by synchronous motors of 1,000 kva. operating on 5,000 volts. The three pumps are capable of dewatering the dock in four hours, pumping at a rate of more than 75,000 gpm. per pump.

The pumps draw from the main suction chambers, located below the pumphouse floor, and discharge by way of reinforced concrete culverts through 6-ft. dia. gate valves. Each pump has an automatic rapid-closing valve on the discharge side to avoid excessive speed in reverse of the pump and motor when shut off, as the pumps are some 40 ft. below water level. Another automatic self-closing valve is fitted to the suction side of each pump. To impound water in the dock above tide level, the delivery of one main pump can be bypassed into one filling culvert.

Special pumps handle dock drainage and seepage water. Also in the pumphouse are two fire pumps capable of delivering 1,825 gpm. against a head of 270 ft. and three circulating pumps supplying the 21-in. dia. saltwater main in the lower subway.

The main culvert valves, four of which are 9 ft. in dia. and nine 6 ft. in dia., are of the double-faced wedge type and are operated by an electric motor attached through worm and wheel gearing. Pumps and main valves are operated by remote control from a central point. The system is electrically interlocked to insure correct sequence of operations.

The dock is served by two electric traveling cranes, each of 50-ton capacity and 110-ft. radius and have an underclearance of 110 ft. above low water. An auxiliary hoist has a capacity of 15 tons at 120-ft. radius. Speed of hoisting with a 50-ton load is 60 ft. per minute. The crane travel on double 111-lb. rails at 30-ft. centers.

The dockyard area generally is served by two diesel locomotive cranes of 5-ton capacity traveling on 4 ft $8\frac{1}{2}$-in. gage railway tracks. Towers of the large crane are designed to permit passage underneath of rail traffic, including the locomotive cranes.

To facilitate the handling of ships and the gate caissons there are twelve capstans of the constant current type, each capable of exerting a pull of 20 tons at a speed of from 10 to 40 ft. per min.

Thirty-three acre cofferdam

Construction of a cofferdam, inclosing 33 acres, surrounding the graving dock site was started in 1941 following an intensive investigation of the site,

which included making more than 200 pipe and wash bores and taking 22 cores of 3 in. dia. made with a diamond drill plant.

The cofferdam is made up of two separate embankments, each extending from the mainland at Potts Point to Garden Island. The embankments consisted essentially of sandstone ballast banks retaining a clay core, in the center of which a steel sheetpile wall was driven.

Rock protection for core

The first stage of construction consisted of placing ballast (rock) toe banks, about 70 ft. each side of the cofferdam centerline. Ballast was dumped by hopper barges, located in position from temporary timber piles previously driven by a floating pile frame. Clay "hearting" was then dumped between the ballast banks by the same means to a level about 7 ft. below the crest of the banks.

The second stage ballast was then placed partly on the lower banks and partly on the clay to bring the outer face of the bank up at the required slope and to provide no less than 10 ft. of cover over the clay. By taking advantage of the tides, it was possible to use hopper barges to bring the ballast up to 3 ft. below low water, above which hand dumping from shallow draft, flat-top punts was used up to about half-tide level.

Immediately following the first stage of bank construction, a temporary timber staging was constructed along the centerline of the embankment to carry the pile-driving frames for sheetpiling. Four frames were used, two on each of the cofferdams. One driver had to be specially built to handle the 70-ft. lengths of piling required over a portion of one embankment. The second stage clay hearting, together with the final ballast capping at the sides and top of the bank, was dumped from trucks operating on the timber staging. As the banks approached final level, the superstructure of the staging was removed, the supporting piles being left in.

The sheetpiling used weighed 50 lb. per lin. ft. and was obtainable in lengths up to 60 ft. All pieces over that length had to be spliced.

In general the piling was driven to rock, using double-acting hammers operated by compressed air. In cases where is was impractical, because of depth, to drive to rock the piles were founded in clay overlying the rock.

While the cofferdam was under construction, two dredges, one of the ladder bucket type and one duplex grab, were employed to remove as much as possible of the soft material overlying the rock on the dock site. About 170,000 cu. yd. of sand and clay were removed in this way before the closing of the cofferdam made it necessary for the dredges to leave the area.

Weir accommodates tides

For closing the cofferdam, alternate piles over a wall length of 200 ft. were cut through at low water level, and the upper sections raised and wedged up to form a series of weirs. These provided sufficient waterway to prevent excessive velocity and scour through the final gap in the piling as the last few piles were driven. An apron of ballast was placed in front of the openings to prevent scour of the clay hearting adjacent to the piling.

At closure time, as the water inside the cofferdam approached its minimum level due to tide flow, the wedges were knocked out and the upper lengths of piling driven down to close the gaps. Clay was then dumped alongside the piling to complete the seal, and the bank finished in the ordinary way.

Movement from dewatering

As soon as the cofferdam was completed, in February, 1942, dewatering was commenced by the use of pumps mounted on barges and discharging over the embankments through a flexible jointed floating pipelines. Sumps had previously been dredged to provide for drainage of the areas as dewatering was completed. The water level was lowered in 5-ft. stages every five days, the pumping generally occupying 2 to 2½ days. The balance of the period was allowed for drainage and consolidation of the embankments.

A close check was kept on the movement of the embankments during dewatering and for a considerable time thereafter. An appreciable amount of lateral movement of the sheetpiling occurred—a maximum of more than 2 ft. being observed. Some vertical settlement also took place but in no case were the movements serious enough to cause any trouble.

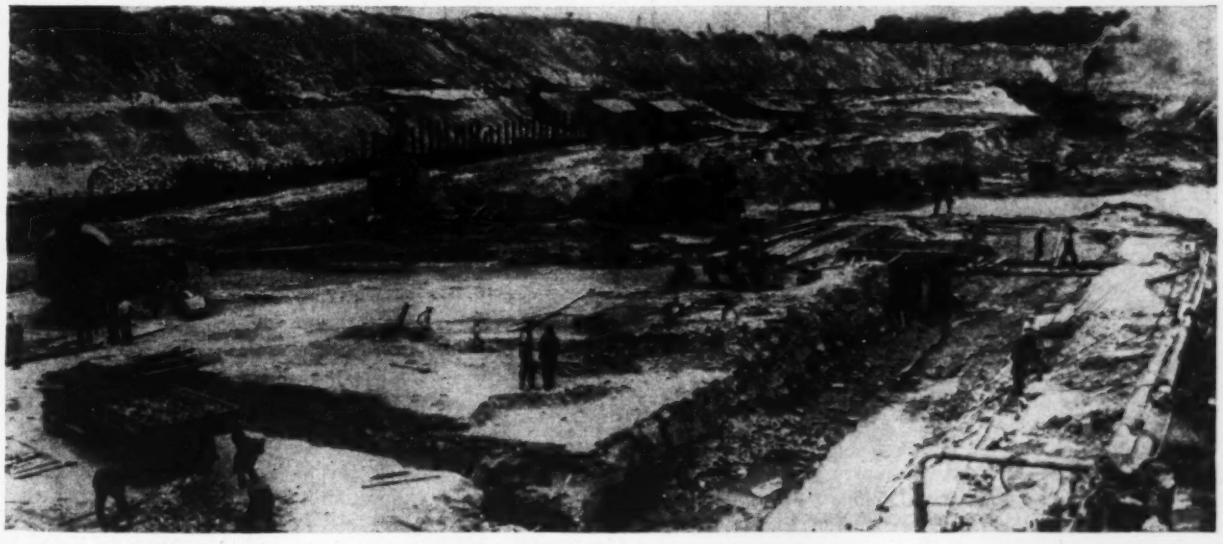


Fig. 5. Excavation inside the cofferdam. Trenches in foreground are to accommodate culverts for flooding and unwatering.

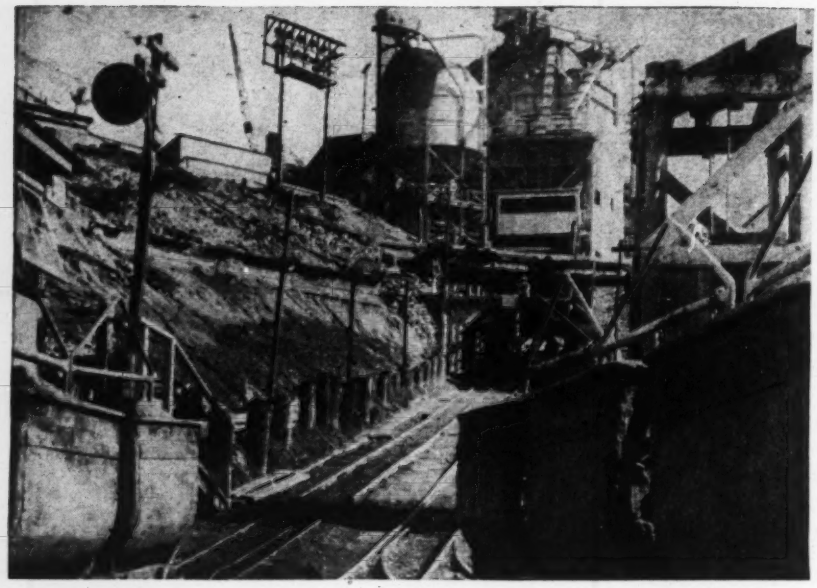


Fig. 6. Concrete from a central mixing plant was hauled to the placing equipment by diesel locomotives.

The cofferdam proved entirely effective. The greatest rate of leakage was some 20,000 gph. for a wall length of over 4,000 ft. despite a head of some 75 ft.

Most of the inflow occurred at a point of junction of the cofferdam with reclaimed land on shore. It was alleviated by extending the sheetpiling inshore utilizing short lengths of piles.

Extensive and rapid excavation

Crawler-type steam and diesel-powered shovels were used for excavation, as many as eleven units being in operation at one time, ranging from ⅝-cu.yd. to 2½-cu.yd. capacity. Disposal was accomplished with the aid of motor trucks, all suitable material being placed on the inner sides of the cofferdam embankments to form part of the permanent back-filling.

The rock formation at the site rose to form a ridge linking Potts Point and Garden Island, falling away generally to the northeast and southwest. On the ridge, the quality of rock proved so satisfactory that in place of the 8 ft. originally contemplated, a minimum depth of 5 ft. of concrete for the floor was decided on, over the area from the main sill to the intermediate caisson groove. Beyond this to the inshore end of the dock, however, the rock was not good. In one area it was necessary to carry the excavation to about 70 ft. below low water, making the floor 25 ft. thick at that point.

The total quantities of excavation carried out in the dry over the area of the dock and entrance basin amounted to some 120,000 cu. yd. of rock and 260,000 cu. yd. of other material.

To prevent, as far as possible, the passage of pressure water into the sandstone rock of the foundations, an extensive program of grouting was carried out around the perimeter of the excavation. Holes were drilled about 20 ft. into the rock at 10-ft. intervals and grouted at a pressure of 40 psi. In addition, the rock below the cut-off walls across the dock entrance and under the caisson grooves was grouted to a depth of 25 ft. at 60 psi

Concrete mixing and placing

The greater part of the concrete poured was supplied from a central mixing plant established on the foreshore of Potts Point opposite the southern end of the dock. Aggregates were brought in to a high-level street above the plant and distributed by belt conveyors to bins built on the cliff face below.

From the bins, another system of conveyors delivered the aggregates to the batching bins at the tops of the mixing plant, whence it passed the batching hoppers to three mixers of 2-cu. yd. capacity each. All batching was done by weight—cement, aggregates and water being weighed separately.

Bulk cement was used at the central plant, being brought by barge to a temporary wharf at the southern end of the reclaimed area. It was picked up from the barge floor by two electric-pneumatic cement pumps and transported by pipeline to a silo adjacent to the plant. Provision also was made for the use of bagged cement, handled by an elevating conveyor to the silo.

Telpher transporters used

The general scheme for concreting the dock called for the central mixing plant to deliver concrete to the bottom of the excavation by 1-cu. yd. skips, Fig. 6, lowered down a ramp behind the shore end of the dock. There they were hauled by narrow-gage diesel locomotives to overhead telpher transporters, Fig. 7, that lifted the bucket and placed the concrete. The transporters moved longitudinally along the dock on rails laid on the outer units of the floor, where concrete had previously been placed by mobile cranes.

The best day's output when this plant was in full operation was some 1,900 cu. yd. during three shifts. The total concrete placed in the dock and adjacent structures was 310,000 cu. yd.

The dock floor was concreted in blocks, generally 22½ ft. long by 20 ft. to 25 ft. wide, placed alternately with an interval of six weeks between adjacent blocks, to minimize contraction cracking. Because of the necessity for speed, however, it was not possible to adhere to this sequence, particularly with the outer blocks carrying the rails for the telpher transporters. In such cases, provision was made for grouting the joints.

Hydrostatic relief

To prevent the development of hydrostatic uplift beneath the floor, a system of half-round 6-in. dia. earthenware drains was laid on the rock foundation of each block before concreting. These were led to a central 4-in. dia. earthenware pipe riser, which was brought up as concreting progressed. A hole was drilled below each central riser to a depth of 70 ft. below low water; the pipes terminated at finished floor levels in a ball and socket hydrostatic relief valve. Similar drains were laid at intervals across the foundations of the wall units and brought up to relief valves at the edge of the floor.

The mass concrete of the floor was initially terminated at a level 2 ft. below desired final surface. This provided a working surface during con-

struction for accurately positioning inserts for holding keel-blocks and the like. The floor was finally finished off with a 1-ft. 8-in. thick layer of richer concrete topped with a 4-in. layer of granolithic surfacing, placed as dry as possible before the lower concrete attained its initial set. The surface of each block was divided into four panels to reduce surface cracking.

Provisions for expansion

The dock walls were built in units 40 ft. long with 5-ft. gaps between the 40-ft. lengths, these gaps being concreted eight to twelve weeks after the equivalent pour in adjacent blocks. This period allowed most of the initial shrinkage of the concrete in the 40-ft. blocks to take place, while still allowing for some further shrinkage to provide for subsequent reexpansion.

Pipe and cable connections to the surface from the wall galleries were largely concentrated in the 5-ft. sections. This permitted the main wall units to be built up to cope level more quickly by eliminating the special work needed to accommodate connections.

Provision was made against water leakage at wall construction joints by forming a 6-in. dia. hole across the joint. After the walls had been brought up to final level the holes were thoroughly heated and dried out, then filled with bitumen. Pipes were left in the holes to allow reheating of the bitumen, should it subsequently harden and become ineffective. To prevent leakage into the galleries, watertight seals of bent copper strip were set in the concrete across construction joints.

Mass concrete was placed in lifts of about 4 ft. Plywood was used for formwork throughout and proved quite satisfactory. The general method of fixing face forms was for the bottom to be held in by bolts and the top to be tied back by hooked rods to "hair-pin" set in the top of the previous lift. This eliminated the necessity for the use of long profile timbers and considerably lightened the forms, a point of importance in the 40-ft. lengths used on the wall units. [A study of the author's pictures indicates the use of what construction men in this country know as horizontal studs and vertical wales, thus eliminating the heavy horizontal wale often used.—EDITORS]

Except for the reinforced concrete piles, which were made with normal portland cement, low-heat cement was used for all parts of the work. The 28-day test results with this cement were generally very satisfactory but, particularly during cold weather, the concrete was rather slow to harden. Temperature records taken during the summer in large pours at the bases of the walls indicated a maximum temperature rise of 35 to 40 deg. F.

Concrete mixes varied in cement content from 4½ cu. ft. per cubic yard with 3-in. aggregate, used for mass concrete in the floor and walls, to 11 cu. ft. per cubic yard, with 1½-in. aggregate, for special locations in the culverts where excessive velocities and turbulence might occur. Slumps generally were restricted to a maximum of 2 to 3 in., depending on mix and location. All concrete was compacted with internal vibrators operated by compressed air.

Masonry grooves for caissons

The caisson grooves were built of granite masonry, some blocks weighing over four tons. In the walls, the concrete was kept to a level one course below the masonry, and on the floor a 2-in. recess was formed between the

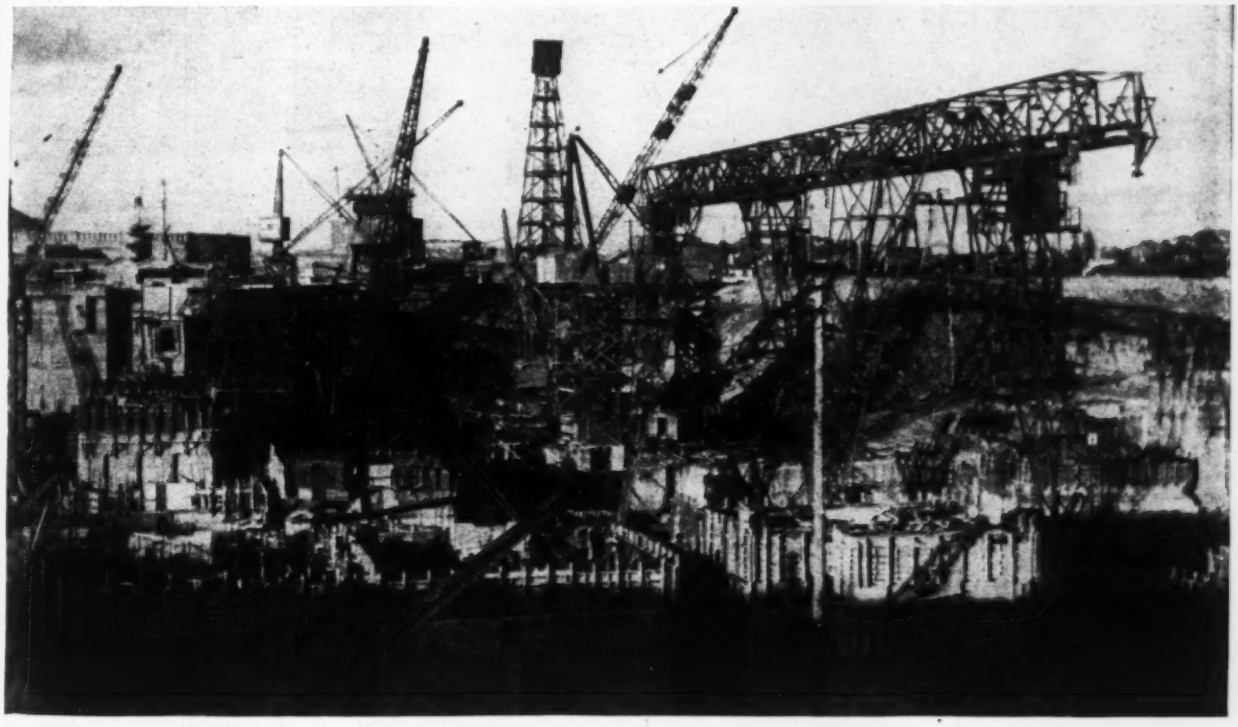


Fig. 7. Concrete was placed in the structure by the telpher transporter at the right. The entire frame moved on rails on the dock floor. A car suspended under the truss, having its own power, traveled transversely across the structure and had a hoist for lifting loads, operated by a man riding the car.

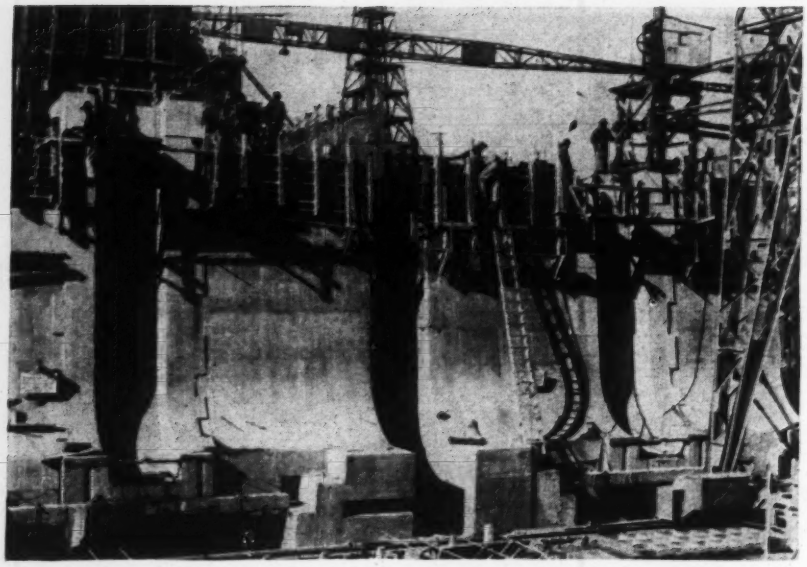


Fig. 8. Main and emergency caisson grooves at the dock entrance. Note the 5-ft. section of the wall (center of the photograph) left for filling after adjacent 40-ft. monoliths have taken their early contraction.

back of the stones and the concrete, which was later rammed with a special coarse, dry mortar. Although during construction the blocks were set with great care, it was not possible to achieve the necessary trueness of face and the grooves were finally dressed with pneumatic tools.

The two caissons were built within the cofferdam alongside one of the entrance wharfs thus overcoming the difficulties of launching craft of such deep draft by making it merely a matter of flooding the dock and entrance basin. The construction of the caissons was started as soon as the area had been excavated to its final level of 43 ft. below datum, and wharf completed sufficiently to carry the cranes necessary for handling of steelwork.

By September, 1944, construction on the gate caissons and on the dock had reached a stage sufficiently advanced to permit flooding the cofferdam. When flooding was completed one of the caissons, though unfinished, was placed in the emergency groove and the dock pumped out.

After the caisson and the drainage pumps had proved themselves capable of keeping the dock dry, work was started on the removal of the section of the cofferdam embankment that extended across the entrance basin and prevented entry. The sheetpiling wall and the old timber piles of the temporary staging were withdrawn without much difficulty, with the aid of special pile-extracting gear and a 130-ton floating crane.

The removal of the ballast and clay forming the embankment was carried out by two 4-cu. yd. draglines working from the top of the bank to about 35 ft. below low water, with a ladder bucket dredge removing the balance to a depth of 43 ft.

Unusual wharf

The fitting-out wharf built in connection with the Captain Cook Dock also is of reinforced concrete construction. It is supported on two rows of piers, spaced at 40-ft. centers transversely and 30 ft. longitudinally.

The piers are 15 ft. in dia. at the base, founded on twelve timber piles driven to rock. About 12 to 16 ft. above the base the size of the piers is reduced and they are brought up to near low water level as hollow columns of 7 ft. 6 in. external and 3 ft. 6 in. internal diameter, the hollow cores being filled with sand. The piers are terminated in solid heads of rectangular section.

Construction of the wharf was carried out concurrently with that of the graving dock but as a separate unit. Temporary timber-staging was construted along the line of the wharf to support the crane, pile driving frame and other construction plant required.

Steel cylinders, 15 ft. in dia., were jacked down into the sea bed to a depth of 58 ft. below low water, the cylinders being built up in sections as sinking progressed. The clay inside the cylinders was too tough for excavation with a grab bucket so it was cut up by a diver using a high pressure air and water jet. Muck was removed by an air-lift ejector, a method that proved very effective.

Piles driven with follower

When excavation in a cylinder was completed, the hardwood piles were driven to rock by use of a long steel follower, through centering grids placed at the top and bottom of the cylinder. During the driving of the last of the piles in a group it was found that the earlier piles, particularly the four in the center, had a tendency to rise, sometimes as much as 9 in. Careful measurements were made immediately after driving the pile and again at the conclusion of driving the group. Any piles found to have risen were then redriven. In most cases the redriven piles finally reached a penetration greater than their initial driving, although the specified set had been obtained under the original driving.

After the piles had been driven, concrete was poured around them by tremie to form a plug in the bottom of the cylinder. The cylinder was then dewatered and forms set for placing the remaining concrete in the dry.

A heavily reinforced haunched portal beam, 7 ft. 7½ in. deep, provided the necessary transverse bracing between the front and rear piers. It is sufficiently strong to eliminate the need for diagonal or underwater bracing. A 16-in. thick reinforced concrete deck, surfaced with tar macadam, is carried on longitudinal beams at the front, center and rear of the expansion joints. Bronze and stainless steel sliding plates, are provided at about 300-ft. intervals.

The fitting-out wharf is serviced by an electric-powered traveling crane built very high to permit effective use when an aircraft carrier is alongside. The pins at the heel of the boom are 99 ft. above low water and the rig is capable of lifting 50 tons at 90-ft. radius to a height of 152 ft. above low water.

Exceptionally heavy lifts will be handled by a fixed cantilever crane, which has a capacity of 125 tons at 165-ft. radius and 230 tons at 118-ft. radius; it has a height of 160 ft. above low

water. This crane is carried on four reinforced concrete cylinders, 13 ft. dia. sunk to rock at about 110 ft. below water. The four piers are spaced at 50 ft. centers each way and are tied together above low water by heavy reinforced concrete beams. The crane foundation structure forms part of the fitting out wharf.

Built by government agencies

In 1939 Sir Leopole Savile, of the English firm of consulting engineers, Sir Alexander Gibb and Partners, was commissioned to examine and report on the most suitable site for the dock. The firm of Sir Alexander Gibb and Partners subsequently designed and supplied specifications for the dock and later assisted in supervision of the construction work.

Responsiblity for the construction of the graving dock was vested by the Commonwealth Government in the Department of the Interior. In July, 1940, a Dock Construction Section was formed, which has controlled, co-ordinated and supervised the operations.

To avoid the delay due to waiting for complete plans and specifications, and to put the work in hand as rapidly as possible, it was arranged that sections of the construction should be carried out by those departments and instrumentalities of the State of New South Wales that had suitable plant and staff available.

The Maritime Services Board of New South Wales was thus entrusted with the construction of the cofferdam and the subsequent removal of the section across the dock entrance together with the fitting-out wharf and the keel-blocks for the dock. Excavation, concreting and backfilling of the dock and erection of some subsidiary buildings were carried out by the Metropolitan Water, Sewerage and Drainage Board of Sydney. After the formation of the Allied Works Council, in 1942, labor requirements were mainly filled from that organization.

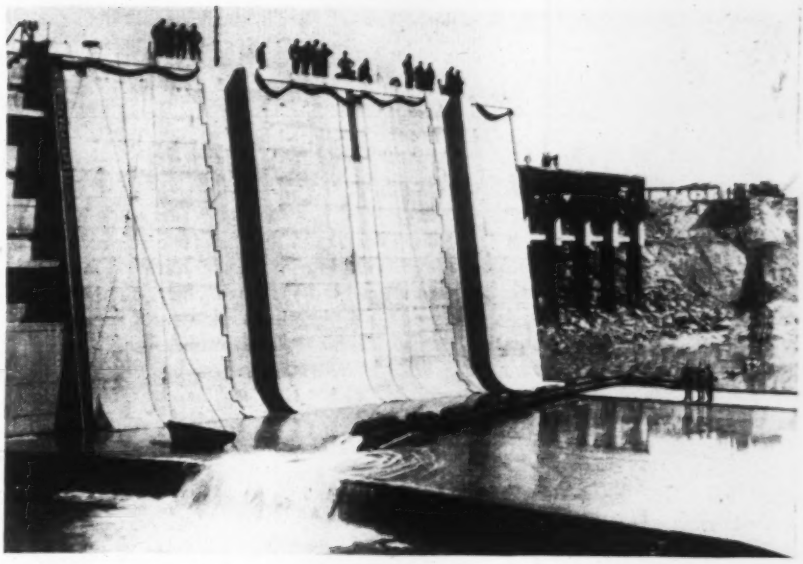


Fig. 9. When the cofferdam was built two 21-in. pipes were inserted below low water to permit gravity filling of the cofferdam after completion of construction.

The caissons were designed by the London firm of Vickers-Armstrong and built by the Sydney Steel Co. The latter firm also is building the 250-ton crane for the outfitting wharf and erecting the graving dock cranes.

Although a number of component parts of the project were not fully completed, the dock itself was put in use early in 1945.

Rubber-Lined Concrete Tanks Store Aviation Gasoline Successfully

Early in the war, when ship construction required all available steel plates, the Bureau of Yards and Docks, Navy Department, turned to prestressed reinforced concrete tanks for fuel storage. Although there were ample and successful precedents for such tanks where water, diesel oil and even ordinary gasoline were to be stored, high octane aviation gasoline, for which much of the new storage was required, presented a new problem. Not only did the gasoline tend to permeate and damage the concrete, but what was more important, the concrete contaminated the gasoline. Experiments with various types of lining resulted in the adoption and use of an aqueous suspension of polysulphide of rubber, known commercially as Thiokol Latex, for covering the floor and walls and the columns that supported the roof (*ENR* Jan. 28, 1943, vol. p. 135, and Dec. 2, 1943, vol. p. 821).

The two tanks described in these articles were built at the U. S. Operating Base in Bermuda in 1942. Of 13,500-bbl. capacity, their design followed the normal construction specification with the exception that salt instead of fresh water was used in the concrete. The synthetic rubber lining reinforced with 4-oz. Osnaburg 26x26 fabric, was placed under the supervision of representatives of Stoner-Mudge, Inc., New York City. During the three-year period of use, no leakage was noticeable and when the tanks were drained the following results of the inspection were reported: (1) There was approximately $\frac{1}{4}$ in. of sludge, consisting mostly of rust, on the tank floor, which is believed to have come from pipelines or tankers. (2) Exposed metal on pump casings, liquidometers, etc., was slightly corroded. This corrosion was not sufficient to warrant cleaning and did not indicate any need for early replacement. (3) Exposed concrete in the roof slab showed no sign of cracking or spalling. There were no rust marks which might indicate corrosion or reinforcing. (4) The lining appeared to have undergone no change after three years' use. The Thiokol was slightly discolored but otherwise still intact. The fabric was tight, and there was no indication of loosening at the joints or

Philadelphia Looks to Upland Sources For its New Water Supply

Storage on upper Delaware and use of river channel below as open conduit are features of recommended 500 mgd. supply project.

FOR more than two decades there has been pressure by individuals, groups and various civic organizations in Philadelphia, Pa., for adoption of water supply sources potentially less dangerous and also free from the objectionable tastes and odors intermittently present in that portion of the city's supply now obtained from the Schuylkill River. It now appears that these aims may soon be realized, as a recent report (*ENR* Dec. 13, 1945, vol. p. 770), made by a board of consulting engineers to the mayor's water commission after study of six proposed projects, recommends abandonment of the polluted Schuylkill source and substitution of upper Delaware River water.

Since 1912 Philadelphia has been furnished with filtered water originating from lower Delaware and Schuylkill river sources. Present withdrawals from these rivers average about 350 mgd., of which about 55 percent is from the Schuylkill; after treatment at the Queen Lane, Belmont and Roxborough filter plants, the latter supply is distributed to the westerly portion of the city. The remainder comes from the tidal portion of the Delaware River, this supply being treated at the Torresdale filter plant. About two million people are served.

Planned for year 2,000

Looking ahead to provide for economic development and increase in population of the city to about the year 2,000, the consulting engineers estimate a demand of 500 mgd. for 2,400,000 persons. In addition to this, all computations for reservoir storage capacity make provision for releases of compensation water required by present laws and regulations.

Of the six plans considered, the board of engineers recommends the so-called "Yardley-Wallpack Bend" project for detailed investigation. The latter provides for construction of a storage reservoir with an earthfill dam in the Wallpack Bend of the Delaware River (see accompanying map); intake works in the vicinity of Yardley; a regulating reservoir at Warrington and conduits for delivery of water to all existing filter plants. Thus, Delaware River water would be furnished to the entire city.

The site of the dam, located in a great S curve of the river about 13 mi. above the Delaware Water Gap, was selected in preference to others downstream because it has the natural advantage of rock walls suitable for making a cut to bypass river flow during construction of the earth dam. This cut can also be used as a spillway channel after completion of the dam, when a concrete spillway would be built in the bypass channel.

Recommended upland source for Philadelphia water supply would store Delaware River water above Wallpack Bend and use the river channel as open conduit to Yardley. At the latter place water would be conveyed to existing filtration plants and a new regulating reservoir by means of deep rock tunnels.

Backwater of the long and narrow reservoir created by the 120-ft. high dam would extend upstream to a point near Port Jervis, N. Y., the lake thus formed providing a surface area of about 15 sq. mi. The tributary drainage area is 3,720 sq. mi., considered ample to sustain the 97,600-mg. capacity provided.

Would generate 60,000 kw.

Water released from storage would travel in the open channel of the Delaware River to the intake works at Yardley, thus eliminating the need for a diversion conduit.

Release of the 500 mgd. from the reservoir could be harnessed to provide some 60,000 kw. of firm power, states the board. It is estimated that this water-power privilege might be worth $100 per kw. to some advantageously situated power company.

From the intake at Yardley, a deep rock tunnel of 16.75-ft. dia. and 16.8 mi. long would lead to the Torresdale filter plant. Midway of this tunnel a pumping station would lift water through 13.2 mi. of 11-ft. dia. tunnel to a regulating reservoir at Warrington. From here, another 11-ft. dia. tunnel would carry the water 14.5 mi. to the filter plants now using Schuylkill water.

Other plans considered

Of the five alternate plans considered by the board, one known as the "Delaware River Project" is quite similar to the recommended plan. In this project, the dam at Wallpack Bend and the regulating reservoir at Warrington would also be constructed, but water would be carried by a conduit between the two, rather than in the river channel. This plan, recommended by Army engineers in 1934, would require 80 mi. of deep rock tunnels.

A second alternate, designated the "Delaware River-Yardley Project", would carry Delaware River water from Yardley to Torresdale through a 14.5-ft. dia. deep rock tunnel, but no storage reservoir would be constructed on the Delaware River. However, five

reservoirs would be constructed on Perkiomen and Tohickon Creeks to serve the Queen Lane, Roxborough and Belmont stations.

Two other plans call for utilization of the upper Lehigh River basin as a source. The first of these, depending entirely on this source, is ruled out because it would furnish only 331 mgd. of the required 500 mgd. The second, however, supplements this source with four reservoirs on adjoining watersheds of the Pocono Mountains. Both plans call for a regulating reservoir on Unami Creek, a tributary of Perkiomen Creek.

The fifth alternate calls for five reservoirs on tributaries of the upper Delaware River and another on a tributary of the Lehigh River. This plan also calls for a regulating reservoir on Unami Creek.

Treatment in existing plants

In all of the plans considered, provision is made for deep rock tunnels to bring the water to the city's filter plants, as this form of aqueduct is considered least liable to interruption of service. In each case filtration is considered necessary in order to develop a safe and satisfactory product. But completion of the present $18,000,000 water improvement plan, involving rehabilitation of existing treatment plants, would provide the necessary purification facilities.

Estimated cost of the upland water source project is unofficially set at about $100,000,000.

Members of the board of consulting engineers studying the matter are: Charles A. Emerson, New York, chairman; Nathan B. Jacobs, Pittsburgh; Gustav J. Requardt, Baltimore; Francis S. Friel, Philadelphia, and Joel D. Justin, Philadelphia. W. D. Williams is executive engineer for the board.

Portland Ore. Sewage Disposal Project Plans Are Nearing Completion

Pollution of the Willamette River at Portland, Ore., will be curtailed by sewerage and treatment plant facilities for which most of the plans had been drawn even before the war ended. Funds are available from a $12,000,000 bond issue approved in May 1944 and work on designs has since been under way, culminating more than 15 yr. of preliminary study in search of the best means of eliminating river pollution.

In recent years these studies have been financed by taxing all sewer connections on the basis of about 12 percent of the water bill. No difficulty has been met in enforcing the ordinance which permits the tax to range as high as one-third of the water bill. Total revenue in the 5 yr. since the ordinance was passed has been about $1,000,000.

Sewage pumped to Columbia River

The need for cleaning up polluted waters at Portland is urgent. The Willamette enters the city with its low-water flow of 4,000 sec.-ft. already heavily polluted by up-river cities and industries. Then in Portland 52 sewer outfalls discharge into the stream, entirely consuming all remaining oxygen and leaving the water in extremely bad condition. Similarly, in sluggish Columbia slough, sewage from densely populated areas has been discharging into water already heavy with industrial wastes. The logical, safe outlet, authorities now agree, is the Columbia River whose flow averages 125,000 to 150,000 sec.-ft. in the season when sewage flow is most objectionable.

The Willamette divides the city into a "west side," including the main business section, many industrial plants and a relatively small residential district, and an "east side," mainly residential and much larger in area.

For the west side, intercepting sewers to be built at some distance back from the river have been found best. These will intercept the flow from all existing outfalls at elevations such that the sewage can be carried to a central west side pumping station to discharge through one inverted syphon under the river into an interceptor on the east side. Automatic pumping stations will receive the sewage from small low lying areas below the gravity interceptors, lifting this flow into the gravity lines.

On the east side a similar collection method will be used—a large gravity interceptor and a few small pumping stations serving the low areas.

Tunnel under business section

One main pumping station in Sullivan's gulch will serve the east side and perhaps also the west side, depending upon whether it is decided to pump in two stages or only one. This main station will have a capacity ranging from 50 to 110 mgd. depending upon whether the west side flow (50 mgd.) is repumped. The static lift at the main station will be 32 ft.

Under the business section of the east side the interceptor will be in tunnel. The sewer will be fairly deep here but an important advantage of the tunnel is in avoiding traffic interference. This and other short tunnels will have a combined length of some 7,000 ft.

Across the ridge of the peninsula which divides the watersheds of the Willamette and Columbia, the sewer will again be in tunnel. This time, with a length of about 17,000 ft., adits and shafts will be used to facilitate construction.

Separate sludge digestion

As the city's sewers are of the combined type considerable sand and gravel are expected in the sewage. This will be removed before it enters the settling basins of the primary treatment plant near the Columbia River. From these basins sludge will be collected mechanically and pumped to separate digestion tanks.

The main outfall sewer (about 8.5 ft. in diameter) is designed to carry 155 mgd., which is the estimated flow from an ultimate tributary population of 600,000 expected by 1980.

Engineering on the project is under contract to a combination of two Portland firms, Stevens & Koon and John W. Cunningham & Associates. An engineering board for supervising the work includes these two firms with Ben S. Morrow, city engineer. A. M. Rawn, Los Angeles, has been a consultant on planning special phases of the work.

German Sewage Treatment Practice Made Little Progress During War

Emphasis placed on industrial waste processing for by-products and the recovery of sludge gas for motor vehicle operation.

Once a leader in development and operation of sewage treatment processes, Germany has lagged far behind practice in the United States, according to Anthony J. Fischer, of the Dorr Co., New York, who reported his observations on a recent trip abroad at a meeting of the American Society of Civil Engineers. "One gathers the impression that sewage treatment plants in Germany during the war were operated solely for the purpose of utilizing digester gas for driving motor vehicles, and that many trade wastes were treated only for the recovery of the valuable constituents that they may contain," reported Dr. Fischer.

Dr. Fischer was a member of a civilian specialist group known as the Technical Industrial Intelligence Committee, sponsored in part by the Foreign Economic Administration, which was designated to investigate what advances had been made in German sanitary practice. Other members of the group were A. E. Gorman of the War Production Board, A. V. Sheridan, Commissioner of Public Works of the Bronx, New York, and Lt. Col. Joseph Gilbert, of the Army Sanitary Corps. Some 60 water, sewage and trade waste treatment projects were visited.

Little new construction

Conditions reflected Germany's complete preoccupation with total war economy wherein sewage treatment had no place except where it directly affected the war effort. Maintenance and repairs were neglected because of the scarcity of critical and substitute materials, while the lack of sufficient labor adversely affected routine operations at sewage treatment plants.

Information secured from consulting engineers and equipment manufacturers led to the conclusion that about 235 sewage and industrial waste treatment plants were built or expanded during the period 1938-1945. Of these, about 50 were for the treatment of municipal sewage, 70 were for industrial waste, and 90 for military installations. The remaining plants served institutional and industrial housing facilities, and included in this list were a number of installations built in occupied territories, chiefly France and Poland.

Unit operations in the newer plants closely parallel those used in the United States. An interesting difference, related Dr. Fischer, was the complexity of the German design, which was reflected both in the concrete work as well as the mechanical equipment.

Of 25 municipal treatment plants visited, only four were in what could be considered normal operation. On the other hand, only five were damaged to any considerable extent by bombing. These were at Essen-Nord, Alte-Emscher, and Karnap in the Emscher district, at Frankfort and at Berlin Wassmannsdorf.

It was pointed out that Dr. Karl Imhoff, famous German sanitary engineer who survived the Nazi debacle, (*ENR* Aug. 30, 1945, vol. p. 264), was designing an activated-sludge plant to treat the sewage from a population of 1,300,000 in the city of Berlin. The design had the interesting feature of being laid out in three separate groups, each of which in turn was divided into three sections. Each section can be operated independently as a separate plant, and it is contemplated that the treatment in one or more sections be carried to a high degree of nitrification and the final effluent circulated to the raw sewage entering all three plant groups. In this manner it was thought that the septic sewage could be made more amenable to the treatment, and at the same time odors would be minimized.

Sludge gas for vehicle operation

Except in a number of plants in the Ruhr district where industrial wastes predominate and the settled sludge is lagooned, raw sludges are generally digested. Practically all digester tanks are heated and provided with gas collection facilities. Use of rotating heating coils for better heat transmission is common. External raw sludge preheaters are used to some extent as are removable internal heating coils. Digester stirring and rotary distribution devices are widely used. Stage digestion is used to a considerable extent.

Much thought is being given to the digestion of farm and other organic wastes for the purpose of gas production and utilization. Pilot plant studies have been made on the reduction of packing-house wastes with this end in view. Tests have also been carried out on the addition of various organic materials to digesting sewage sludge in order to increase gas production.

The utilization of digester gas for driving motor vehicles has been developed to a high degree because of the high cost and scarcity of gasoline. Rather than use the gas for sludge heating or for power generation at the sewage plant, coal and electrical energy have been used for these purposes in order to make a maximum amount of gas available for operation of automotive vehicles.

Common practice, reported Dr. Fischer, is to process stored gas by compressing it in two stages to 14 atmospheres, washing it with water to remove carbon dioxide, and further compressing it in two additional stages to 350 atmospheres. Gas is delivered to consumers at 200 atmospheres pressure in cylinders holding 350 to 560 cu. ft. of gas. About 135 cu. ft. of this gas at atmospheric pressure is equal to one U. S. gallon of gasoline. The purified gas contains 90-94 percent methane.

Cost of compressing the gas, excluding plant amortization charges, etc., was said to be equal to about 10 cents per U. S. gallon of gasoline. Fixed charges on equipment, etc., will about triple this cost for moderate-sized plants.

Future prospects gloomy

Considering the widespread property destruction left in the wake of the war, the future outlook for sewage treatment in Germany is not very bright, according to Dr. Fischer. He believes that existing damage to municipal plants and sewer systems will be repaired, but that it is very questionable whether any new plants will be built anywhere in Germany for a long time.

In his opinion there may be some activity relating to the digestion of garbage, farm wastes and other organic materials for gas and fertilizer production. But such plants would be small and would involve only a digester and the necessary gas compression equipment.

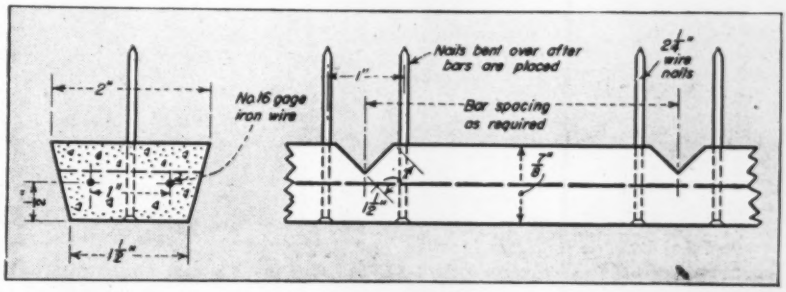
From Field and Office

WORKING PROBLEMS AND TIME-SAVING METHODS FOR ENGINEERS AND CONTRACTORS

Bar and Chair Spacer

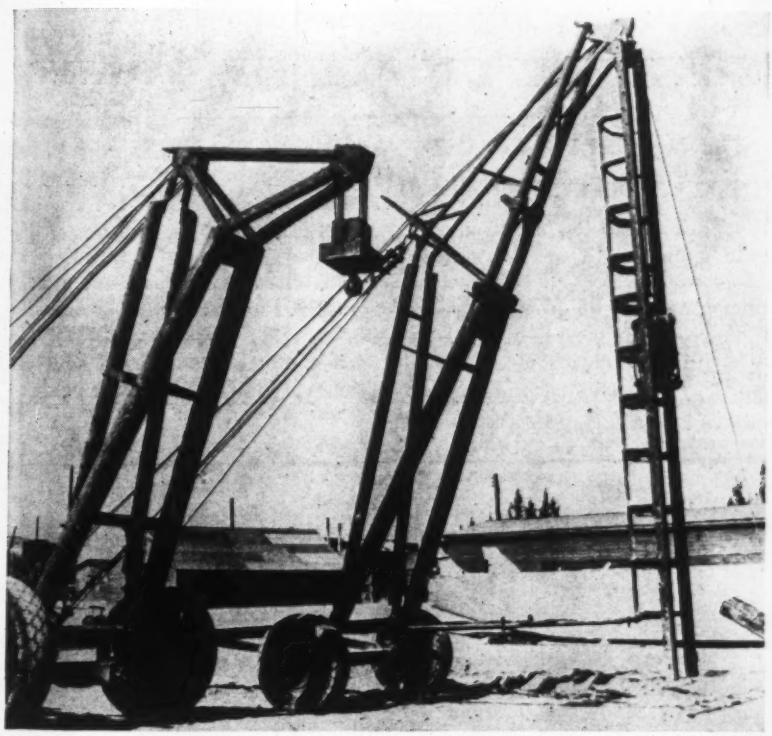
A combination bar chair and spacer frequently used in Brazil may be of interest. These "barras de chocolate", as the workmen dub them, look like gray chocolate bars and may be easily broken at the notches. The size of notch indicated accommodates the usual bars used in slabs.

The bars are composed of a mix of fine stone chips, sand and cement and are cast in gang molds, which are made of hard wood by a good joiner and which consist of a base platen, a pair of ends and removable division strips and half square strips for forming the notches. To provide for the various bar spacings found on the plans, the division strips are notched. The holes drilled in the platen for locating the nails embedded in the concrete "bars" are drilled on such centers as to provide a fairly universal job mold and of such size that the nails may be pushed in by hand. Filling of the molds is usually done by some man who makes a price for the filling, emptying and stacking of the bars at so much per hundred.



Notches in bar and chair spacer often used in Brazil are sized to accommodate bars commonly specified for slabs.

Usually made in meter lengths and weighing 5 lb., the bars frequently crack in handling but are kept from separating by the embedded wire. They are easily separated at the notches by a blow from a hammer and chisel.—CHAS. JAY SEIBERT, *Washington, D. C.*



PILE DRIVER MADE FROM TRACTOR-DRAWN CRANE

Personnel of the Landing Craft Salvage School at the U. S. Naval Amphibious Training Base at Fort Pierce, Fla., have turned out a rugged and effective pile driver by a few alterations to the boom of a tractor-drawn crane. Adaptable for handling piles up to 25 ft. long and adjustable for batter, the rig was constructed entirely of salvaged material. It is readily movable and can be operated by any tractor with a two-drum power take-off. One line is used to handle the drop hammer, the other for picking up piles.

Roller Racks for Handling Core Boxes

Bringing in heavy boxes of earth samples and rock cores from twelve to fifteen scattered locations where subsurface investigations are in progress has been solved for the Department of Public Works of New York City by adaptation of a station wagon. The cores and samples must be carefully examined and classified at the office of the Subsurface Exploration Section, and many of them must be gone over by the senior geologist, before they are stored for subsequent examination by bidders. The boxes, especially those containing rock cores, are quite heavy.

The work of bringing boxes in as they are filled, and replacing them with empties, is done with the station wagon shown. As it carries regularly six to a dozen boxes, the job of stacking them

George Eckstein, chief inspector for the Department of Public Works, New York City, demonstrates roller racks he devised for handling core boxes in and out of station wagon.

up and pulling them down proved so warm in summer that George Eckstein, the chief inspector, designed and had built in the Department Central Motor Repair Shop, racks with small pipe rollers on bolts, so that the long core boxes could be rolled in and out on top of one another.—HENRY D. HAMMOND, *Civil Engineer, Department of Public Works, New York.*

New Type Gutter Lining Used on Virginia project

As part of an attempt to obtain a more economical type of lining for gutters in highway cuts, the Virginia Department of Highways is experimenting with a type of lining new to that department. It consists of concrete blocks laid as illustrated by the accompanying photograph. Measuring 3x 8x16 in., the 27-lb. blocks are manufactured at a commercial plant of a good grade of concrete.

In preparing the ditch for the lining, the slope next to the bank is made 1 on 2 and the edge adjacent to the shoulder is sloped 1 on 4, the bottom being made horizontal. The blocks are laid on a 2-in. thickness of coarse sand screenings with the space between the blocks made about $\frac{1}{4}$ in.

As a last operation the joints in the lining are sealed with a hot asphalt filler. For this work an RC-1 asphalt of 85 to 100 penetration is used and the mineral filler content is 15 to 25 percent. The filler is added at a temperature of about 300 deg. F.

The bid price on the lining shown was about $3.00 per sq. yd., but on future contracts a much lower cost is anticipated. The lining is used only on gutters of 3 percent or greater slope.

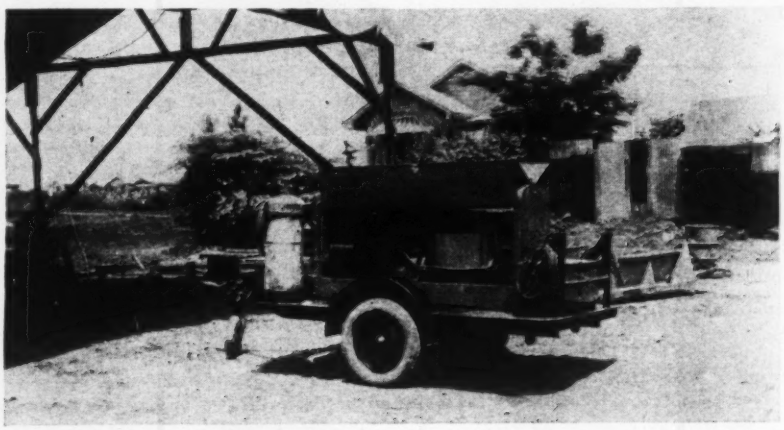
Left: To reduce maintenance cost the Virginia Department of Highways is lining the gutters on a project on U. S. Highway 1 with 3-in. thick concrete blocks laid on coarse sand screenings. The joints are filled with hot asphalt. Right: A completed section of the lining

The lining was developed under the direction of H. J. Neale, landscape engineer. The work illustrated was done under the supervision of Clarence Birch, chief inspector, and was part of a 4.5-mi. project south of Fredricksburg on U. S. Highway 1. E. W. Hechler, Richmond, Va., was the general contractor.

Trailer Mounted Welding Unit Saves Time on Repair Work

The work of moving a 300-ampere electric welding unit to locations in the field where pieces of construction equipment were needing repair was expedited by use of the job-built trailer illustrated in the accompanying photograph. Oxy-acetylene tanks for cutting are transported on the front end of the trailer, and at the back end a tool box and coiled welding leads are provided. The entire assemblies are protected by upright guards.

The unit was designed and built by the 821st Engineer Aviation Battalion while in the Manila area, Philippine Islands. Road tests proved the unit had excellent "trailing" characteristics.



Much time was saved by the Aviation Engineers in repairing equipment in the field by means of this trailer-mounted welding unit that carries apparatus for both electric welding and gas cutting.

Comment and Discussion

Readers' opinions on matters that concern engineers and contractors

Origin of Moment Ratios

Sir: A number of engineers have called my attention to the articles, "Moment Ratios Simplify Continuity Analysis," by Frederick S. Merritt (*ENR* Nov. 1 and 15, 1945). They have stated that much of the material in this article has been taken from my writings and that no credit for the source has been acknowledged.

I have accordingly read these installments carefully and find that there is considerable truth in these statements. In particular the concepts of a unit prototype beam with its functions, of moment ratios, C-values and their estimation, parts of the procedure with variable beams, the concepts of moment of inertia and of third moment of loading groups, computation of restraining moments at supports in terms of C-values, placing the load for maximum and computation of maximum by the aid of curves, the procedure in the handling of sidesway, as well as some of the nomenclature and figures are in basis quite the same as will be found in material of my own, much of which has existed in copy-righted form since 1933. This is true even though the author has, in some cases, clothed these concepts in somewhat altered mathematical dress.

I call to your attention that this material has been used without my permission and without acknowledgment of credit for its source. Such procedure seems to me to be somewhat unfair in dealing with concepts, some of which are unique. This is particularly so when consideration is given to the fact that Mr. Merritt was a former student in my course in indeterminate structures.

R. C. BRUMFIELD
Assoc. Prof. of Civil Engineering
The Cooper Union for the Advancement of Science and Art
New York

Sir: I am glad to acknowledge my indebtedness to Prof. Brumfield, although I believe his claim for credit for the information presented in my articles appears to be much too broad. The fact is that the sources of information to which I am indebted are so numerous that giving credit to all in the limited space available was impracticable. To credit only a few, seemed obviously to be unfair. Consequently, much as I would have liked to acknowledge the great part Prof. Brumfield has played in the development of continuity analysis, the decision to omit all credit precluded my doing so.

Several other analysists have also pointed out the similarity between my method and those they have published. The resemblance is unavoidable since we are all dealing with single-cycle moment distribution, using the same basic assumptions, and must end up with formulas that yield the same arithmetical results. What I have tried to do is to illustrate techniques for solving, with a minimum of labor, problems that occur on the job. Thus, I have endeavored to reduce the number of formulas needed or to simplify them to an extent greater than has been done heretofore, and to arrange the work for minimum computation. (*Proceedings*, A.S.C.E., Jan., 1946, discussion by writer of paper by Prof. Brumfield).

Admittedly, a portion of the articles is based on Prof. Brumfield's teachings, but his claim for credit would be more reasonable if it were limited merely to some of the formulas for loads on beams of constant *I*. Even here, the formulas in my articles seem to me to be simpler, and the fixed-end moment chart is to my knowledge different from any of his in that it places a load of any type for maximum end moment, at the same time giving the corresponding fixed-end moment.

The remainder of his claims ignores not only my research work in this field but also that of many of his predecessors. For example, the theory of exact carry-over factors was given widespread distribution in *Standards of Design for Concrete*, Appendix D, Bureau of Yards and Docks of the U. S. Navy, No. 3Yb, Nov. 15, 1929, and was covered to some extent in many publications. Formulas for obtaining approximate values of these factors are my own creation and were suggested by me to Prof. Brumfield several years ago. From Ulrik T. Berg's *Structural Bending Moments Simplified*, I obtained the concept of the unit beam and its functions and suggestions for analyzing beams of variable *I*. Sidesway techniques similar to the one in Part II of my articles are given in a great many publications, including Cross and Morgan's *Continuous Frames of Reinforced Concrete*.

FREDERICK S. MERRITT

Guniting Technique

Sir: The conclusion of the article "Gunite Tunnel Lining Test Reveals Difficulties in Application," (*ENR* Nov. 1, 1945, vol. p. 579) infers that, on the basis of an unsatisfactory test, Gunite does not possess the necessary bonding characteristics to produce the full working tensile strength in the steel reinforcing rods, and furthermore, that Gunite does not afford protection of the reinforcing steel against corrosion.

During the past twenty-five years, we have encountered manifold instances in which reinforcing conditions as mentioned in the article have existed, and had hasty conclusions been reached in the first instance, a solution would not have been obtained. However, it is daily practice of this company to shoot Gunite against forms for cylindrical Gunite water tanks, building walls, beams and columns, containing even more reinforcing and closer spacing than indicated in the photographs accompanying the above mentioned article.

Furthermore, we have never considered it satisfactory to apply Gunite normal to the plane of reinforcing, but rather to apply it from both sides in order to eliminate the danger of sand pockets such as occurred in the test of the foregoing article.

We also adhere rigidly to the practice of employing an air blowout hose operated separately, but in conjunction with the nozzle, in order to insure complete removal of any loose particles of sand from behind the reinforcing steel to avoid sand pockets. The photographs accompanying the article do not indicate that a blowout hose was used.

It is unfortunate that the test described in your article should have yielded such adverse conclusions be-

cause tests made in different parts of the world over a period of thirty years have indicated that the bond strength of Gunite is most satisfactory, and as regards protection against corrosion of steel, Gunite has been successfully employed for many years for that purpose.

L. J. SULLIVAN
Chief Engineer
Case Construction Co.
San Pedro, Calif.

Tacoma Bridge Studies

Sir: In the editorial "The New Suspension Bridge," (*ENR* Nov. 29, 1945, vol. p. 714), mention was made of the formation of a committee to study the whole question of suspension bridge design, and this was followed by the statement that "during four years of activity, secrecy and silence have characterized the program so that only a handful of specialists were familiar with the progress being made." This suggests that a deliberate policy of secrecy is being followed, and that results that should be released are being withheld from the engineering profession. I wish to correct any such misconception.

The committee to which you refer is the Advisory Board on the Investigation of Suspension Bridges. It was organized in 1942 by Thomas H. MacDonald, Commissioner of Public Roads, at the request of a representative group of engineers concerned with the problems of suspension bridge design, and held its organization meeting in September of that year. The Advisory Board has been active during the ensuing period of slightly more than three years but, contrary to the implication of your editorial, it has not attempted to cloak its operations in secrecy.

The following list of activities with which the Advisory Board is concerned may be of interest:

1. Cooperation of the Washington Toll Bridge Authority and the Public Roads Administration in a study of the effect of aerodynamic forces on models of suspension bridges. This investigation, which includes certain tests that are of primary interest to the Advisory Board, is the one mentioned by Charles E. Andrew in his article "Redesign of Tacoma Narrows Bridge" (*ENR* Nov. 29, 1945).

2. Cooperation of the American Institute of Steel Construction and the Public Roads Administration in theoretical analyses of the action of suspension bridges when subjected to aerodynamic forces.

3. Cooperation of the Golden Gate Bridge and Highway District and the Public Roads Administration in making observations of the movements of the Golden Gate Bridge.

4. A study of the damping characteristics of structural steel members in the laboratories of the Public Roads Administration.

5. Publication by the Agricultural and Mechanical College of Texas, in cooperation with the Public Roads Administration, of a reprint of the three original official reports of the failure of the Tacoma Narrows Bridge. This publication, which makes these official reports readily accessible, is the only one that has been sponsored by the advisory board up to this time.

Numerous organizations, other than those mentioned above, have made or are making valuable contributions.

It is only since the collapse of the Tacoma Narrows Bridge on November 7, 1940, that there has been full appreciation of the need for a thorough knowledge of the effect of aerodynamic forces on suspension bridges and an effort made to secure that knowledge through carefully conducted research. Such research is time consuming, and dependable results and valid conclusions cannot be expected in a few months.

The advisory board has taken the position, concurred in by all the cooperating agencies, that the release of incomplete data from which incorrect conclusions might be drawn is inadvisable, and that reports of the work with which it is concerned will not be released prematurely.

The final report of the investigations of the Washington Toll Bridge Authority is now in preparation and eventually will be released for publication, but just when this will be cannot be foretold. At the moment the "handful of specialists" who are familiar with the data developed in that investigation include only a few members of the advisory board. The board itself has been supplied only with fragmentary data pending the completion of the final report which, in itself, is an undertaking of some magnitude.

Another report concerned with the mathematical theory of vibrations in suspension bridges is also in preparation, but it will be some time, possibly a year or more, before this can be published.

The observations of the movements of the Golden Gate Bridge have been delayed for more than two years on account of delays due to wartime conditions in securing and installing the necessary instruments. It is hoped that this difficulty will be overcome in the near future but at the present time there are no data to keep secret.

E. F. KELLEY
Chairman, Advisory Board on the Investigation of Suspension Bridges

English Refuse Disposal Practice

Sir: The articles on refuse disposal and snow removal in the various states and cities of the United States are most interesting and instructive.

Our arrangements for warnings of snow have been somewhat different. During the war, all warnings and instructions received have been in code, with indications as to whether light, medium, or heavy falls were expected.

With reference to the articles on the collection of waste food, in this country we have had communal bins in our streets, suitably labelled. These bins are emptied two or three times a week as required. This system has been a great boon, as it separates the putrescible matter from other refuse.

The districts in this country that have adopted the controlled tipping principle, which is similar in detail to sanitary landfills, have found the refuse much easier to deal with, and this principle also prevents the refuse fill from heating too much.

Even in a small area such as this, with only 26,000 population we have averaged between 5 and 6 tons of waste food per week. This covers all expense and leaves us with a reasonable margin of profit. With the collection of paper, tins, bottles, jars, and waste food, my costs show a reduction over pre-war figures. During the past three years we have been in the happy position of being able to dispose of our refuse, pay all the men's wages, and make a profit of between $5,600 and $6,000, which I venture to suggest is a reasonable performance.

G. HOLDEN
Chief Sanitary Inspector
& Cleansing Supt.
Whitley Bay Urban District Council
Whitley Bay, England

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CONTRACT UNIT PRICES

What contractors are bidding on different kinds of construction work

BRIDGE CONSTRUCTION, ORE.

I

OWNER: Oregon State Highway Commission, Salem, Oregon.

PROJECT: Pudding River Bridge Section of Pacific Highway East. Widen 0.25 mile highway; 590 lineal feet of concrete viaduct. and construct 120-foot steel bed arch span. Requires approximately 4,000 cubic yards roadway excavation; 1,500 cubic yards rock base; 1,100 tons asphaltic concrete; 1,300 cubic yards structural excavation; 2,000 feet untreated piling; 1,560 cubic yards concrete; 208,000 pounds metal reinforcement; 294,000 pounds structural steel, and 1,440 lineal feet metal handrail.

CONDITIONS: Contractor to furnish material and complete project in 365 calendar days. Minimum wage rates are: Skilled Labor $1.25 per hour; Intermediate, Group 1, $1.15 per hour; Intermediate, Group 2, $1.00 per hour, and Common Labor, $0.85 per hour.

BIDS: Five bids were received October 29, 1945, ranging from $147,847 to $204,396.

PARTIAL LIST OF BIDDERS:

1. J. F. Johnson, Newberg $147,847
2. Kern and Kibbe, Portland 175,575
3. Marine Contractors, Inc., Portland 184,570

Item	Quantity	Unit Prices (1)	(2)	(3)
1. Clearing and grubbing	All Specified	$1,000.00	$750.00	$2,008.00
2. Trench excavation	40 cu. yds.	2.00	2.00	2.50
3. Borrow excavation	3,100 cu. yds.	0.60	0.50	0.63
4. General excavation	1,000 cu. yds.	0.60	0.60	1.00
5. Short overhaul	13,900 yd. stas.	0.02	0.02	0.01
6. Long overhaul	120 "C" yd. sta.	0.40	0.50	1.00
7. Rounding cutbanks	400 lin. ft.	0.25	0.20	0.16
8. Finishing roadbed and slopes	0.25 mile	600.00	400.00	560.00
9. 12" corrugated metal pipe	160 lin. ft.	2.00	2.00	2.35
10. Concrete inlets	5 only	30.00	40.00	50.00
11. Concrete walks curb	10 cu. yds.	20.00	25.00	25.00
12. 3"-0" gravel in base	1,240 cu. yds.	1.75	3.00	3.00
13. 1"-0" gravel in base and shoulders	260 cu. yds.	2.75	4.00	4.00
14. Sprinkling	40 M-gals.	3.00	3.00	2.00
15. Class "B" asphaltic concrete	1,100 tons	9.00	9.90	9.30
16. Shoring, cribbing, etc.	All Required	4,000.00	7,583.40	12,000.00
17. Structural excavation	1,300 cu. yds.	3.00	2.20	2.70
18. Structural excavation below elevation	100 cu. yds.	5.00	5.00	7.00
19. Furnish untreated piles	2,000 lin. ft.	0.40	0.30	0.44
20. Drive piles	120 only	10.00	20.00	25.00
21. Class "A" concrete	1,560 cu. yds.	32.00	44.00	32.00
22. Metal reinforcement	208,000 lbs.	0.058	0.07	0.06
23. Structural steel	294,000 lbs.	0.108	0.134	0.165
24. Metal handrail	1,440 lin. ft.	8.00	5.90	8.00
25. Preparation of old bridge and provisions for traffic	All Specified	7,500.00	10,472.00	20,580.00

II

OWNER: Oregon State Highway Commission, Salem, Oregon.

PROJECT: Bridge and culverts on Troutdale-Wahkeena Section. Columbia River Highway. Approximately 630 cubic yards Excavation; 720 cubic yards Concrete; 118,000 pounds Metal Reinforcement, and 75 lineal feet Metal Handrail.

CONDITIONS: Contractor to furnish materials and complete project in 275 calendar days. Minimum wage rates are: Skilled Labor, $1.25 per hour; Intermediate Labor, Group 1, $1.15 per hour: Intermediate Labor, Group 2, $1.00 per hour; Common Labor, $0.85 per hour.

BIDS: Ten bids were received October 29, 1945, ranging from $32,467.50 to $47,860.00.

PARTIAL LIST OF BIDDERS:

1. Archie R. Averill, Portland, Oregon $32,467.50
2. C. J. Eldon, Portland, Oregon 33,055.00
3. Lockyear and White, Woodland, Washington 38,022.50

Item	Quantity	Unit Prices (1)	(2)	(3)
1. Structural excavation	630 cu. yds.	$5.00	$4.00	$5.00
2. Class "A" concrete	720 cu. yds.	30.00	30.00	37.00
3. Metal reinforcement	118,000 lbs.	0.06	0.07	0.065
4. Metal handrail	75 lin. ft.	8.50	9.00	7.50

HIGHWAY SURFACING, NORTH DAKOTA

OWNER: North Dakota State Highway Department.

PROJECT: Surfacing 23.864 miles of highway and grading 4.744 miles; stabilized base 140,238 tons; procuring and laying 2,108 linear feet of reinforced concrete pipe culverts varying from 18 inches to 72 inches. Project located on U. S. Highway No. 10, near Glen Ullin, West in the counties of Morton and Stark, North Dakota.

CONDITIONS: Contractor to furnish all materials and complete work in 150-16 hour working days. Rail and highway transportation facilities available. Minimum stipulated wages are $.90 per hour for skilled labor; $.70 per hr. for semi-skilled; $.50 per hour for common.

BIDS: Six bids were received July 27, 1945. Ranging from the contract low of $505,214.04 to $693,192.74.

LIST OF BIDDERS:

1. Northern Improvement Co., Fargo, N. D. (contract) $505,214
2. Megarry Bro's., St. Cloud, Minn. 565,460
3. Inland Constr. Co., Omaha, Nebr. 601,909
4. W. H. Noel Co., Jamestown, N. D. 626,839
5. Northwestern Engr. Co., Rapid City, S. D. 627,424
6. Haggart Constr. Co., Fargo, N. D. 693,193

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Roadway excavation	284,496 c. y.	$.20	$.18	$.27
2. Water for compaction	3,749 m. gal.	1.00	2.50	.80
3. Scoria sub-base	10,113 c. y.	.50	1.00	1.16
4. Stabilized base	140,238 tons	1.45	2.00	1.76
5. Furnish and apply bit. MC-1 or 2 (prime)	178,840 gals.	.11	.10	.13
6. Blotter sand	1,511.7 tons	2.00	2.00	1.60
7. Combined aggregate	36,267 tons	2.50	2.40	2.86
8. Furnish Bitumen MC-5 for mix	471,472 gals.	.17	.10	.11
9. Furnish & apply bit. MC-5 for seal	149,922 gals.	.11	.11	.13
10. Seal aggregate, grade 2	3,285.5 tons	5.00	4.00	5.60
11. Rip rap (cement joints)	390 s. y.	4.00	3.00	6.45
12. Concrete monument	1	10.00	10.00	10.00
13. Seeding (type C)	89.3 acres	15.00	12.00	42.00
14. Sodding	7,048 s. y.	.40	.35	.47
15. Relay pipe (all sizes)	146 l. f.	1.00	1.50	1.20
16. Reinf. conc. pipe culverts 18"	180 l. f.	2.40	2.50	3.00
17. Reinf. conc. pipe culverts 24"	776 l. f.	3.20	3.45	4.20
18. Reinf. conc. pipe culverts 27"	62 l. f.	4.00	4.00	5.40
19. Reinf. conc. pipe culverts 30"	236 l. f.	4.50	5.00	6.47
20. Reinf. conc. pipe culverts 36"	206 l. f.	5.00	7.00	8.80
21. Reinf. conc. pipe culverts 42"	92 l. f.	7.70	8.25	12.40
22. Reinf. conc. pipe culverts 48"	80 l. f.	9.80	9.75	13.40
23. Reinf. conc. pipe culverts 60"	164 l. f.	16.90	13.25	20.20
24. Reinf. conc. pipe culverts 72"	312 l. f.	26.20	19.00	27.00
25. Reinf. conc. flared end section, 18"	16	20.00	19.00	26.00
26. Reinf. conc. flared end section, 24"	28	25.00	25.00	35.00
27. Reinf. conc. flared end section, 27"	1	30.00	29.00	43.00
28. Reinf. conc. flared end section, 30"	8	35.00	34.00	50.00
29. Reinf. conc. flared end sections, 36"	6	60.00	55.00	80.00
30. Reinf. conc. flared end sections, 42"	4	80.00	65.00	97.50
31. Reinf. conc. flared end sections, 48"	4	90.00	80.00	120.00
32. Clay pipe underdrains 6"	114 l. f.	2.00	1.00	1.10
33. Class 1 excavation	337 c. y.	5.00	1.50	5.20
34. Class A-1½" concrete	182.2 c. y.	45.00	40.00	44.80
35. Reinforcing steel	19,698 lbs.	.10	.10	.12

Excavate at New Low Cost with INTERNATIONAL Tractors

THE use of International Diesel TracTracTors for digging basements and other excavations is a distinctly advanced practice. Costs are lowered materially; the work is speeded; time is saved. Many operators who have specialized in excavation work with these TracTracTors enjoy a remarkable volume of business because of these advantages.

In homesite subdivision developments, whole blocks of basements are often excavated in one operation by a single International Crawler!

The International TD-14 TracTracTor shown in the photographs is owned by a basement specialist in the midwest. At this particular site, it was excavating 420 cubic yards of clay. Average depth was 6 feet. Average distance from cut to spoil was 60 feet. Time required to complete the excavation was 6½ hours. Total cost for fuel, lubricants, operator's and helper's wages was under $15.00. The tractor arrived in the morning, finished the job in the afternoon and was on its way to the next job before the day's end!

International Diesel TracTracTors are instant-starting, fast-working and dependable crawlers that get work done at lowest cost—that keep going month after month with minimum maintenance. Visit the International Industrial Power Distributor near you for further information about International Tractors and Engines. See their many superior features. Check with him on the new units and matched equipment now available.

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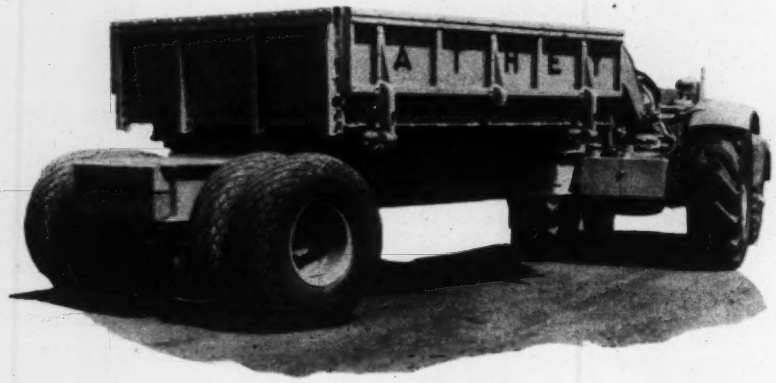
INTERNATIONAL INTERNATIONAL HARVESTER **Industrial Power**

New Aids to the Constructor

MANUFACTURERS' LATEST DEVELOPMENTS IN EQUIPMENT AND MATERIALS



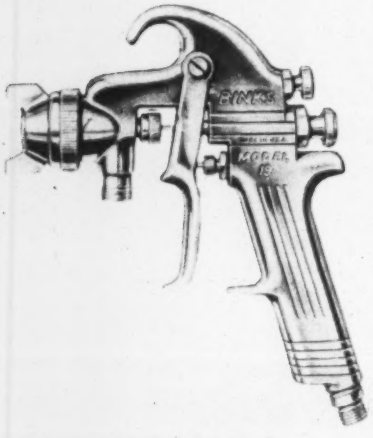
Rubber-Tired Trailer

With a maximum capacity of 15 tons, a new two-way dump trailer, PD-10, is designed for use with the Caterpillar DW-10 tractor for high-speed hauling on construction and earthmoving projects.

This hydraulically controlled trailer has a shipping weight of approximately 15,000 lb., 10 cu.yd. heaped capacity, and struck, 8 cu.yd. It will discharge its load from either side at a 55-deg. angle, and is mounted on 1400x20, 16-ply tires.—*Athey Products Corp., 5631 West 65th St., Chicago, Ill.*

Spray Gun

Many advantages are found in a new Model 19 spray gun, according to the manufacturer's statement. Its well-balanced weight is 1 lb. 7 oz., the grip is designed to fit comfortably into the hand, and a large air passage through the gun results in better air utilization. All controls are conveniently located at the back, and the spray pattern is quickly adjustable from round to flat,



with all widths in between.

The gun has few parts. The body is lightweight aluminum; air nozzle, bronze; fluid nozzle, special hardened steel. The gun is heavily nickel-plated, with a hardened plate where the trigger contacts the air valve stem. The self-centering type nozzle is designed on the tapered seat principle, and air cannot leak back through the retainer ring.—*Binks Manufacturing Co., 3114-40 Carroll Ave., Chicago 12, Ill.*

• • •

Brush Cleaner

A new hand-operated brush cleaner, "Spin A Brush," is said to spin brushes clean in 90 seconds or less, and to make it possible to salvage old, hardened brushes easily. This device is sturdy, compact and high geared, with a permanent plated rustproof finish, an indestructible plastic handle and a Chrysler Oilite thrust bearing. It weighs 3 lb.—*Nashway Co. Ltd., 1401 West Pershing Road, Chicago 9, Ill.*

• • •

Solderless Wiring Kit

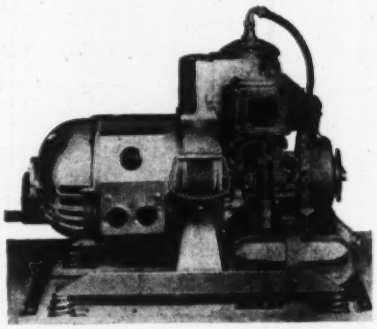
A complete wiring repair kit for making quick, vibration-resistant connections without solder, is said to be easy to use. The kit contains an all-purpose precision installation tool to cut and strip the wire and attach AMP terminals to the wire, and 100 pure copper AMP terminals of the most widely used types.

The connections are made by inserting stripped wire in the terminal barrel and crimping with the tool.—*Aircraft-Marine Products, Inc., 1599 F North 4th St., Harrisburg, Pa.*

• • •

Rubber Sealed Generator

A small, gasoline-resistant synthetic rubber seal, less than ¼ in. dia., in the carburetor needle valve adjustment, contributes largely to the versatility of a new portable generator. This Hycar seal is said to provide the exact properties to insure the sensitivity and dependability of the needle-valve adjustment. It will retain its sealing qualities at temperatures down to −65 deg. F., without



adhering to the metal shaft or binding.

The generator itself, which has many peacetime uses in construction, provides 2,000 watts at 120 volts, D-C; it weighs only 105 lb. and measures 24x 17x21 in. It will operate efficiently in extremes of heat and cold, and at any altitude.—*The Homelite Corp., Port Chester, N. Y.*

• • •

V-Belt Sheave

A new and effective means of mounting and demounting V-belt sheaves is presented by the Taperlock V-belt sheave. This provides a mounting of minimum dimensions for accommodation of screws and their connection with hub and bushing and permits the use of a flangeless bushing.

The wedging action of the sheave gives the equivalent of a shrunk-on fit on the shaft, whether standard or normally undersize, it is stated.—*Dodge Mfg. Corp., Mishawaka, Ind.*

Courtesy of Lone Star Cement

uniformity makes the big difference

THE WEATHER'S ALWAYS FINE... UNDER QUALITY CANVAS

Under long buffeting by weather and wear, a tarp or windbreak can get pretty tired. And that's just the time when top-grade cotton and uniform fabric weave show their extra hold-out qualities of strength, toughness and weather resistance—qualities you'll find every time in MT. VERNON Extra duck.

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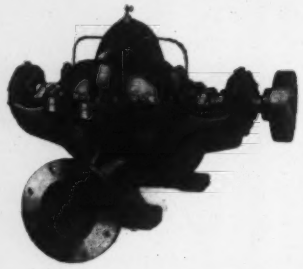
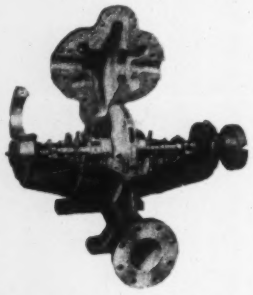
HORIZONTAL PUMPS

Precision-built by

PEERLESS



Peerless (formerly Dayton-Dowd) Horizontal Centrifugal split case or solid volute pumps, single and multi-stage are found wherever reliability, dependability and economical operating costs are desired. Engineered and manufactured with a view to long life, Peerless Pumps are available for all classes of pumping requirements.



HORIZONTAL PUMPS FOR:

Water Towers • Boosters • Fire Protection • Boiler Feed • Condensate • Sewage • Chemicals

VERTICAL PUMP TYPES:

Deep Well Turbine • Hi-Lift (Moyno Type) • Centrifugal • Sewage • Jet • Shallow Well • Hydro-Foil (propeller)

The right pump for the right job. All inquiries and specifications processed by trained engineers.

Ask for name of Distributor nearest you.

PEERLESS

PUMP DIVISION

Food Machinery Corporation

Factories: 301 W. Ave. 26, Los Angeles 31, Cal.
Quincy, Ill. Canton 6, Ohio

Manufacturers' Activities

HORACE A. DEANE, works manager of the Brake Shoe and Castings division of American Brake Shoe Co., has been appointed a vice-president of the division. Mr. Deane is in charge of operations in 18 of the company's 57 plants, and is responsible for the production of brake shoes and miscellaneous iron castings.

H. A. Deane

Irving F. Wagner, manager of American Brake Shoe's Kellogg plant at Rochester, N. Y., has been made a vice-president of the Kellogg Division. Mr. Wagner has been associated with Brake Shoe since 1923, and during the war was contracts officer.

I. F. Wagner

HENRY CROWN has been elected chairman of the board of directors of Material Service Corp., following his retirement from active service with the U. S. Army Corps of Engineers. Associated with the builders' supplies firm since its establishment in 1919, Crown resigned as chairman of the board membership. For the last two years he was chief of military supply for the Great Lakes Division of the Army Engineers in Chicago.

THE TEXAS CO. has appointed A. D. Stivers manager of its asphalt sales department, to succeed Frank V. Widger, who has retired. Mr. Stivers has been associated with the marketing of Texaco asphalt products in the road building and other fields for the last 26 years. From 1919 to 1939, he operated in the southwest, first as representative and later as district manager. Transferred to New York, in 1939, as assistant manager of the asphalt sales department, he held that post until recently appointed manager. Sales of Texaco asphalt throughout the United States now come under his supervision.

WALTER F. SCHOTT has been elected a director of the Cleveland Pneumatic Tool Co. and its wholly-owned subsidiaries, Cleveland Pneumatic Aerol, Inc. in Euclid, Ohio, and Cleveland Pneumatic Tool Co. of Canada, Ltd. in Toronto, Ont. This action followed the acquisition by the Schotts and their associates of the preferred stock and better than 97% of the common of the parent company at a reported price of $4,150,000. Harold C. Schott, brother of Walter, was made a director and vice-president. In addition to the Schott brothers, Wendell A. Falsgraf, Harry C. Burns, and Coleman Harris were elected to the board.

C. B. MCGEHEE, who was on leave from the Truscon Steel Co., Youngstown, Ohio, as a lieutenant colonel in the Office of Strategic Services, is again general manager of sales. C. J. Gelhaar, assistant sales manager of the window and door division, becomes sales manager of the door division, and G. J. Casey becomes sales manager of the metal lath division. R. D. Snodgrass has resigned as chief engineer after 36 years, and is succeeded by W. D. Morehead, manager of the erection department. George McDermott, erection superintendent in New York City, becomes manager of the erection department.

FLOYD S. ADAMS of Ada, Okla., has been added to the sales staff of Worthington Pump and Machinery Corp.'s construction equipment division. Adams has been assigned to cover Texas and Oklahoma, handling portable air compressors, air tools, concrete pavers and mixers for Worthington under Harry J. Schultz, manager of the central region, Chicago.

Adams is an old-timer in the field of construction equipment and is already well acquainted in his assigned territory, having handled various manufacturers' lines before. He was recently relieved of his responsibility in a Texas war industry, after devoting three years to that work.

L. H. GEGENHEIMER, after a 4-year leave of absence for war duties in Washington, is back with The Timken Roller Bearing Co., Canton, Ohio, as sales engineer in the industrial division. He was first loaned by Timken to the British Ministry of Supply, where he was until December, 1943; after which he became a dollar-a-year man with the

24 REASONS for making the next one a LORAIN!*

1. Center Drive turntable.
2. Permits concentrating power on any one operation.
3. Permits spreading power for high-speed simultaneous operations.
4. Two-piece swing drums, roller bearing mounted, reversible bands.
5. Extra wide crowd clutch, roller bearing mounted.
6. Hydraulic coupling—no stall, no shock, no loafing; (used on L 82 and L 820).
7. Center "Chain" Drive crawler.
8. Two travel speeds either direction.
9. Steers either direction.
10. Safety travel and tread lock.
11. Mechanism runs in oil bath.
12. Generous underneath clearances.
13. Centralized lubrication.
14. Wider treads.
15. All-welded shovel boom (strength; all-steel; torsion-resisting).
16. All-steel welded dipper stick.
17. Dipper door stops to protect stick.
18. "Elbow action" power dipper trip.
19. Simultaneous hoist, swing and travel (or boom derricking).
20. High-speed boom hoist—power controlled boom derricking and lowering.
21. "Cable-Miser" fairlead with interlocking, geared sheaves.
22. Bolted butt crane boom connections, easy and quick to assemble.
23. All-purpose Crane Boom Head—6 part reeving with no top block; greater vertical reaches.
24. Backdigger Boom—with controlled tilting dipper; digs a vertical wall, a level floor, dumps exactly where wanted.

NOTE: All Lorain machines are fully and easily convertible for use as cranes, clamshells, draglines, shovels and backdiggers. Don't buy a single-purpose machine; keep future jobs in mind. One machine—one investment—can do a wide variety of jobs for extra profits!

***These features apply to Lorains of 1¼ cubic yards capacity and up**

Reg. Trade Mark

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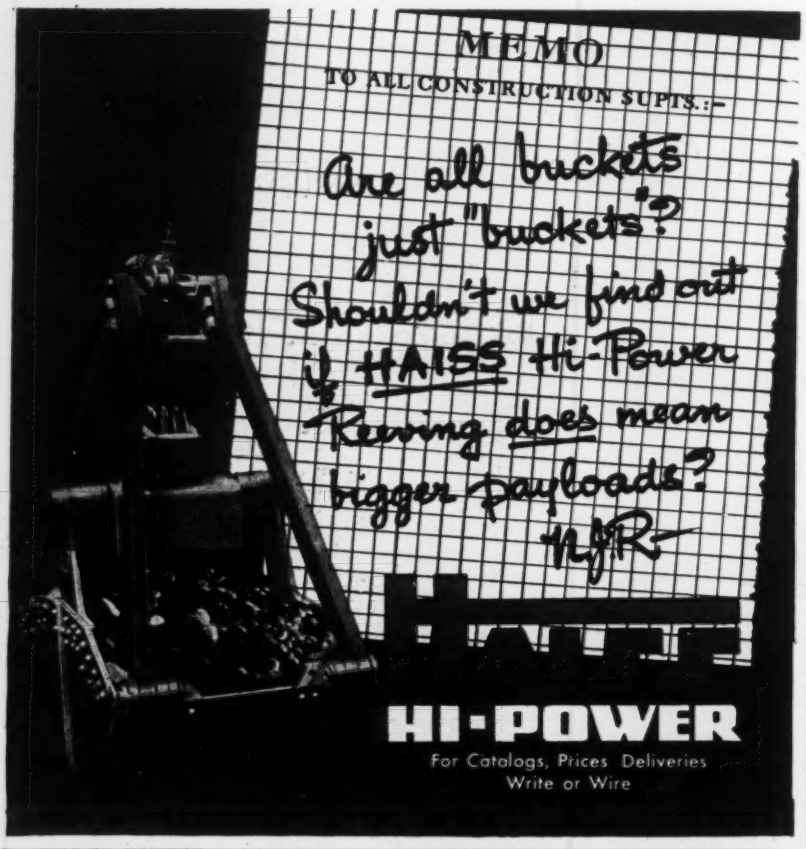
THE THEW SHOVEL CO.
LORAIN, OHIO

CRANES • SHOVELS • DRAGLINES • MOTO-CRANES



The JACKSON
HYDRAULIC
VIBRATOR
Exceptionally
ADVANTAGEOUS for
GENERAL CONCRETE CONSTRUCTION
Through many years of actual service the JACKSON HS-A1 has thoroughly demonstrated that it is the most dependable and efficient, all-around concrete vibrator for the general concrete contractor. It's virtually trouble-free and does a perfect job of handling the stiffer, more economical mixes. Oil-powered, gas engine-hydraulic pump drive. 4000 to 7000 V.P.M. Vibrator head 2¾" x 21". May be quickly fitted with head for wet or dry rubbing.
The JACKSON line contains the ideal vibrator (internal or external) for every type of concrete construction. Write for information on the type you are interested in.
ELECTRIC TAMPER & EQUIPMENT CO.
LUDINGTON MICHIGAN

War Production Board. Then he became chief of the bearing branch of the tools division, a post formerly held by Howard C. Sauer, another Timken employee, now head of Timken's foreign division.

BECAUSE the name corrugated steel sheet piling has caused some misunderstanding of its structural characteristics, the Caine Steel Co. of Chicago, Ill., has renamed the product, Corr-Plate steel piling. This product is made by corrugating steel plates to give the piling the greatest strength possible per pound weight of steel and high section modulus.

The appointment of Carl G. A. Schmidt as manager of the new products division has just been announced by E. P. Monroe, secretary of the Hercules Steel Products Co., Galion, Ohio. A graduate mechanical engineer of Columbia University, Schmidt has had considerable experience in the design, application and sales of materials handling, quarry and construction equipment. He has served as equipment engineer for the Pennsylvania Department of Highways and has been associated with various equipment manufacturers.

The new products division, which Schmidt heads, will develop, improve and standardize new products already in production, including the Hercules power chute, a new unit that provides swift, economical handling of coal and other bulk materials, as well as other new products to be offered to the trade in the near future.

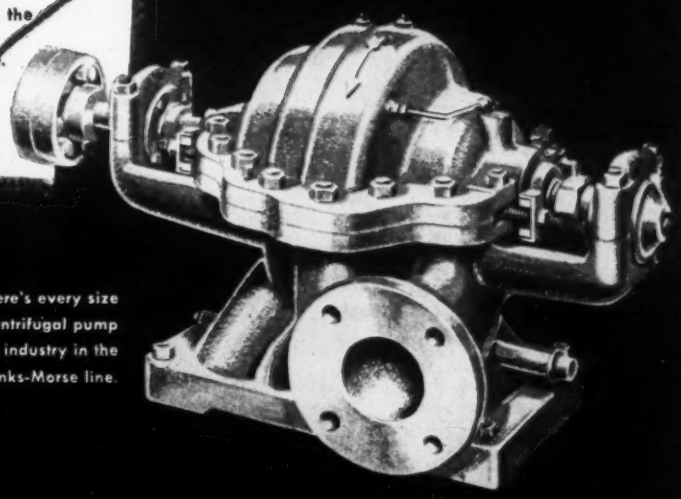
Lieut. Commander Anthony Anable, U. S. Naval Reserve, now on terminal leave, is rejoining The Dorr Co.—engineers, New York, as director of public relations and advertising.

Commander Anable has been on military leave from company since shortly after Pearl Harbor. As navigating officer of an aircraft carrier, he participated in four major naval actions in support of the invasions of Southern France, the Philippines, Iwo Jima and Okinawa.

Commander Anable, a veteran of World War I, served in the Navy's Cruiser and Transport Force which, in 1917-18, transported the first American Expeditionary Force to France.

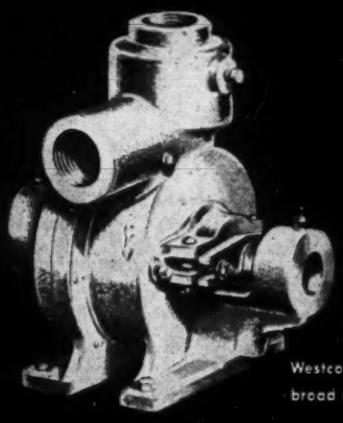
Can ANYONE make a Pump?

Well, there's no law against it—except perhaps the "law of survival." It's a question of what *kind* of pump you want—and how *good* you want it to be. If you want a pump that will squeeze the last fraction of a cent in value out of the monthly power bill, that is designed to the very limits of hydraulic knowledge—built with the fine tools and complete facilities that such precision design requires—you'll want a Fairbanks-Morse pump.

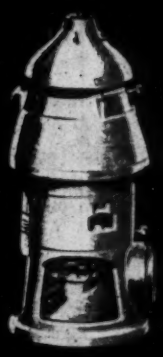


There's every size and type of centrifugal pump used in industry in the Fairbanks-Morse line.

WHEN YOU BUY a Fairbanks-Morse, Pomona or Westco pump, you get a design which is the result of accumulated years of research in not only our own laboratories but those of the universities' scientists whom we have retained!



Westco pumps: precision-built, broad in application.



For all vertical turbine pump work—the Pomona line

THIS DESIGN and unlimited manufacturing facilities which only the largest pump manufacturers can offer you, combine to give you pumps superior in performance and reliability.

ANYONE CAN MAKE A PUMP—perhaps! But for proved value, skilled service—regardless of the type of pumping requirements or the amount of liquid to be moved—Fairbanks-Morse is an unquestioned leader. Call your nearest Fairbanks-Morse distributor or branch office.

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PUMP DIVISION

This One Respirator does the job of Four

Yes, workers get 4-way safety with this Willson respirator. Protects lungs against 4 different industrial hazards. Metal fumes. Pneumoconiosis-producing dusts. Toxic dusts. Nuisance dusts.

Two double filters provide extra-large filtering area. Give workers the greater comfort of free-and-easy breathing. Filters are throw-away type. May be easily, inexpensively replaced.

Face piece available in two sizes to fit either small or large face. Both sizes carry Bureau of Mines approval. Compact, the respirator may readily be worn under a welding helmet.

For help on your lung-protection problems, get in touch with your Willson Distributor or write direct to Dept. EN-12

GOGGLES • RESPIRATORS • GAS MASKS • HELMETS

WILLSON DOUBLE

PRODUCTS INCORPORATED

READING, PA., U. S. A. Established 1870

Elections and Activities

W. G. Bryant, Griffin, has been named president of the Georgia Water and Sewage Association. Other new officers are Comer Turley, Lindale, first vice-president; B. L. Coburn, Fitzgerald, second vice-president, and Van P. Enloe, Atlanta, secretary and treasurer. Two district committeemen elected were W. C. Hartman, Milledgeville, and D. H. Hurst, Tifton.

W. O. C. Scott, assistant superintendent of the structural division of the Dominion Bridge Co., Vancouver, has been elected president of the Association of Professional Engineers of British Columbia. T. H. Crosby, district manager in Vancouver for the Canadian Westinghouse Co., was elected vice-president. The retiring president is F. M. Knapp, assistant professor of forest engineering, University of British Columbia.

Lt. Col. George R. Schneider of Little Rock, chief of the Engineering Division of U. S. District Engineers, was elected president of the Mid-South Section, American Society of Civil Engineers, at the recent annual meeting. George L. Koomos, Vicksburg, Miss., was elected vice president and Ben Dees, Little Rock, secretary-treasurer. Board members are Col. I. G. Norton, Memphis, and William Turnbull, Vicksburg. The Mid-South Section comprises Arkansas, Mississippi and Tennessee.

R. C. Pybus, Commonwealth Construction Co., Ltd., has been elected chairman of the Vancouver, B. C. branch of the Engineering Institute of Canada. Vice-chairman is J. P. Fraser; secretary-treasurer, A. M. Eyre, branch news editor. P. B. Stroyan; executive, R. Rennie, J. M. Rothwell, R. M. Walkem (two years), R. A. Emerson, G. W. Allan, N. D. Lambert, A. Peebles; councilor, Dean John Finlayson.

The Arizona Sewage and Water Works Association has elected officers and directors as follows: E. S. Borgquist, professor of civil engineering, University of Arizona, Tucson, president; Harold Yost, of Yost & Gardner, consulting engineers, Phoenix, first vice president; A. W. Miller, representative Johns-Manville Sales Corp., Phoenix, second vice-president; Geo. W. Marx, director Sanitation Division, Arizona State Department of Health, Phoenix, secretary-treasurer, and association representative on the Board of Control, Federation of Sewage and Water Works Association. All of these were reelections, conducted by post card vote, except for the newly-created office of first vice-president. Directors are the officers, and H. H. Idle, secretary, Arizona Edison Co., Phoenix, Guy Rhoads, superintendent Safford Municipal Utilities, Safford; A. L. Frick, Jr., sales manager Wallace & Tiernan Sales Corp., Los Angeles, Calif.; Dario Tavaini, superintendent sewage dispostal works, Phoenix; R. M. Cushing, consulting engineer, with Headman, Ferguson & Carollo, Phoenix; Merrill Biggs, assistant superintendent, water department, Tucson.

D. B. Packard has been elected president of the Wilmington, N. C., Engineers Club to succeed C. H. McAlister. Other new officers elected are: Cecil Mathes, vice-president; H. E. Hicks, secretary-treasurer; and G. G. Thomas and C. H. McAlister, directors. Retiring officers besides McAlister are: T. R. Cobb, vice president; H. E. Hicks, secretary-treasurer; and J. B. Lashley and G. G. Thomas, directors.

James J. Wass, Warren, Ohio, engineer, was elected president of the Mahoning Valley Society of Professional Engineers at a recent meeting in Youngstown. Other officers elected are: Henry J. Waldeck, deputy county engineer, Trumbull County, vice president; Albert Coope, Mahoning County sanitary engineer, secretary; Clyde E. R. Wenrich, treasurer; Harry A. Loria, H. T. Williams and Bruce W. Weaver, directors.

J. M. Jarrett, Raleigh, N. C., director of the division of sanitary engineering of the North Carolina State Board of Health, has been elected president of the North Carolina Academy of Public Health.

Howard E. Moses, chief engineer of the Pennsylvania State Department of Health, has been elected chairman of the waste committee of the State Sanitary Water Board.

William E. Collings has been installed as 1946 chairman of the New Jersey section of the American Water Works Association. He is superintendent of water and sewers for the borough of Collingswood. Collings, who is also president of the South Jersey Association of Water Superintendent Officers, an affiliated group, succeeds G. D. Norcom, Red Bank. E. D. Sheehan of the Camden, N. J., bureau of water was installed as a trustee.

MEN AND JOBS

William J. Heiser, chief engineer of Lockwood Greene Engineers, Inc., New York City, has been elected vice-president. A civil engineer graduate of New York University, Mr. Heiser started in the office of the bridge engineer of the Long Island Railroad, and has served successively with the Turner Construction Co., American Concrete Steel Co., National Bridge Works; as bridge designer for the New York Central Railroad, structural designer for Westinghouse, Church, Kerr and Co., and as chief engineer of Maynicke and Franke, architects, prior to his affiliation with Lockwood Greene Engineers, Inc., 20 years ago, where he has served successively as head of the structural and architectural departments, as supervising engineer on many projects, and for the last year as chief engineer.

V. R. Smitham, acting city manager of Dallas, Tex., for almost five years, has been appointed city manager. Smitham holds a master's degree in civil engineering from Texas A. and M. College. He has served as assistant engineer of Collin County, and as county engineer of Rockwall County. He has also served the M.-K.-T. Railroad in Texas as general construction foreman, assistant division engineer and field engineer. He has been city manager of Lufkin, Big Spring and Wichita Falls, Tex.

Col. Charles L. Hall, Ohio River Division engineer at Columbus from May, 1941, to September, 1945, recently named North Atlantic Division engineer at New York, has been awarded the Distinguished Service Medal for building $1 billion worth of ordnance plants, camps, airfields, hospitals, etc., handling $800 million worth of engineer supply orders, and helping get small warships, built in the safety of the Ohio Valley, down two rivers to the sea.

Maj. William H. Franklin, Springfield, Ill., contractor, has been placed on the inactive roster of the Army and will return to his contracting business. On March 15, 1942, he was assigned as a captain in the Corps of Engineers, his first major project being the construction of the Lincoln ordnance plant, Springfield. Other projects in which he directed construction included the sanitarium built for returned veterans at Battle Creek, Mich.

James F. Parkinson has resigned as Portsmouth, Ohio, city manager to assume a similar post in Bay City, Mich. He formerly was assistant city engineer in Columbus and Cincinnati.

J. C. Bisset has been promoted from assistant director of public works at Dallas, Tex., to assistant city manager. He succeeds **Homer A. Hunter** who becomes manager of Lubbock City.

Bisset, a native of Kansas, was graduated in civil engineering from the University of Kansas in 1924. He worked for civil engineering firms in Dallas and elsewhere in Texas for several years and became state engineer and assistant regional engineer of WPA in the thirties. He served from 1937 to 1941 as city engineer at Corpus Christi and went to the Dallas Public Works Department in 1941.

Bisset entered the Army in July, 1942, served as post engineer of Borden General Hospital at Chickasha, Okla., for a year, and for the remainder of the war he was engineer of the port of embarkation at New Orleans, La., with rank of lieutenant colonel.

J. H. Bell of Portland, Ore., planning consultant engineer, has been employed to assist the city planning commission at Tacoma, Wash.

Capt. H. H. Terhune, USNR, public works design supervisor at the Marine Base at Cherry Point, N. C., has been promoted to his present rank from that of commander. Before being called to active duty in 1941, he was with the Bureau of Yards and Docks at Washington, D. C., and prior to going to Cherry Point was on staff duty at Pearl Harbor.

W. W. Pollock of Raleigh, N. C., engineer for the North Carolina State Budget Bureau since 1943, has resigned to become associated again with Northrup and O'Brien, Winston-Salem, N. C., architectural and engineering firm.

H. Hershey Miller, formerly with the Pennsylvania State Highway and the Pennsylvania Turnpike Commission, has been reappointed as a special engineer representative with the Pennsylvania Sand and Gravel Producers' Association.

R. J. Middleton, former assistant chief engineer, has been appointed chief engineer of the Chicago, Milwaukee, St. Paul & Pacific Railroad to succeed W. H. Penfield, retired.

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